Vol. 84 NOVEMBER-DECEMBER 1957 No. 6

UNIVERSITY OF MICHIGAN
JAN 21 1958
SCIENCE LIBRARY

Bulletin

of the

Torrey Botanical Club

CONTENTS

Taxonomy of Capsicum Sinense Jacq. and the Geographic Distribution of the Cultivated Capsicum Species. *Paul G. Smith and Charles B. Heiser, Jr.* 413

New Names in Argythamnia Subgenus Ditaxia. *John Ingram* 421

Ganoderma Lucidum, a Parasite of Shade Trees. *P. P. Pirone* 424

A New Cuscuta from South Africa. *T. G. Yuncker* 429

Oil Drops and De Barry "Bubbles" in Ascospores. *B. O. Dodge* 431

Physiology of Growth and Reproduction in Rice. I. Effect of Plant Growth Substances on an Early Variety. *G. Misra and G. Sahu* 442

Torreya
An Annotated Preliminary Catalogue of the Vascular Flora of Rockland County, New York (Concluded). By J. Harry Lehr. Field Trip Reports. Book Reviews. 450

Index to American Botanical Literature. 459

Index to Volume 84. 472

Published for the Club bi-monthly
by
THE BUSINESS PRESS, INC.
N. QUEEN ST. AND McGOVERN AVE.
LANCASTER, PENNSYLVANIA

THE TORREY BOTANICAL CLUB

Officers for 1957

President: H. W. Rickett

Vice-president: Donald P. Rogers

Recording Secretary: Frank G. Lieb

Corresponding Secretary: Peter K. Nelson

Treasurer: Rita M. McMahon

Editor: Charles A. Berger

Manager for Publications: Jack McCormick

Bibliographer: Mrs. Lazella Schwarten

The Bulletin of the Torrey Botanical Club

Editor

Charles A. Berger

Associate Editors

Irving W. Bailey	Edwin B. Matzke
Stanley A. Cain	Wendell H. Camp
Adriance S. Foster	Donald P. Rogers
Barbara McClintock	H. W. Rickett
Murray F. Buell (Memoirs)	Frederick Kavanagh

John A. Small (Torreya)

Membership dues should be sent to Dr. Rita M. McMahon, Fordham Univ., New York 58, N. Y. Subscriptions and correspondence about advertisements and back numbers should be addressed to Dr. Jack McCormick, Amer. Museum of Nat. History, New York 24, N. Y. Manuscripts intended for the Bulletin should be sent to Dr. C. A. Berger, Biological Laboratory, Fordham University, New York 58, N. Y. Material for Torreya should be sent to Dr. John A. Small, Douglass College, New Brunswick, N. J.

Claims for missing numbers must be made within 60 days from the date of issue. Changes of address of members should be sent to the treasurer.

The subscription price of the Bulletin of the Torrey Botanical Club (including Torreya), is $9.00 a year except to active members of the Club. The annual membership dues covers a year's subscription to the Bulletin.

Entered as second-class matter October 8, 1940 at the post office at Lancaster, Pa., under the Act of March 3, 1879. Accepted for mailing at the special rate of postage provided for in the Act of February 28, 1925, embodied in Paragraph (d-2) Section 34.40 P. L. & R. of 1948.

BULLETIN OF THE TORREY BOTANICAL CLUB

VOL. 84, NO. 6, PP. 413–420 DECEMBER, 1957

TAXONOMY OF *CAPSICUM SINENSE* JACQ. AND THE GEOGRAPHIC DISTRIBUTION OF THE CULTIVATED *CAPSICUM* SPECIES

PAUL G. SMITH AND CHARLES B. HEISER, JR.[1]

Within the past few years it has been recognized that a number of distinct species of *Capsicum* were brought into cultivation in the Americas in pre-Columbian times. Recently Heiser and Smith (1953) summarized information about four species, *C. annuum* L., *C. frutescens* L., *C. pendulum* Willd., and *C. pubescens* R. & P., and indicated that still another cultivated species might exist. This paper pertains to that species, *C. sinense* Jacq., and also outlines what is now known concerning the distribution of these five species. Since certain areas, particularly in South America are little known botanically, the possibility exists that other species may have been brought into cultivation also.

During the past 10 years, seeds have been obtained from many sources; and observations have been made of living plant material grown at either Davis, California; Bloomington, Indiana, or both. In addition, herbarium material has been consulted at the University of California, the Weigand Herbarium and the Bailey Hortorium at Cornell University, New York Botanical Garden, United States National Herbarium, Missouri Botanical Garden, and the Chicago Museum of Natural History. Herbarium specimens of all the material grown for this study have been deposited at Indiana University.

In the course of this study, material from Central and South America was obtained which did not fit into any of the species recognized in our earlier paper. It became apparent, on morphological and genetic grounds, that an additional species was involved. We therefore present the following emended description of *C. sinense*.

Capsicum sinense Jacques, Hort. Vind. 3:38. t. 67. 1776. Plants 1.5 to 2.5 feet tall. Leaves and stems essentially glabrous, rarely densely short pubescent, leaves ovate to ovate lanceolate to 10.5 cm. broad, smooth or rugose, light to dark green. Flowers 3–5 per node except in depauperate individ-

[1] A portion of this work was done while the junior author held a fellowship from the John Simon Guggenheim Memorial Foundation in 1953. Financial assistance from the McIlhenny Co. of New Iberia, Louisiana and from a Research Grant from the University of California to the junior and senior authors, respectively, is also gratefully acknowledged.

The authors are indebted to Dr. C. O. Sauer for encouragement and many helpful suggestions, and to the Rockefeller Foundation for making available for study in 1955 its collection of peppers of Mexico.

We are also indebted to many others in this country and in Latin America for much valuable material and information.

[THE BULLETIN for September–October 1957 (84: 337–411) was issued October 17, 1957.]

uals. Pedicels declinate, rarely erect, at anthesis relatively short and thick, ratio of pedicel width (at the base of the calyx) to length 1:8 to less than 1:15. Calyx without teeth and with marked constriction at the base or rarely with an indistinct constriction. Corolla greenish-yellow or rarely fairly clear white; 0.5 to 1.0 cm. in length; lobes not spreading, usually with conspicuous folds at sinuses or sometimes long attenuate without folds. Anthers blue to purple (yellow anthered forms were found in two

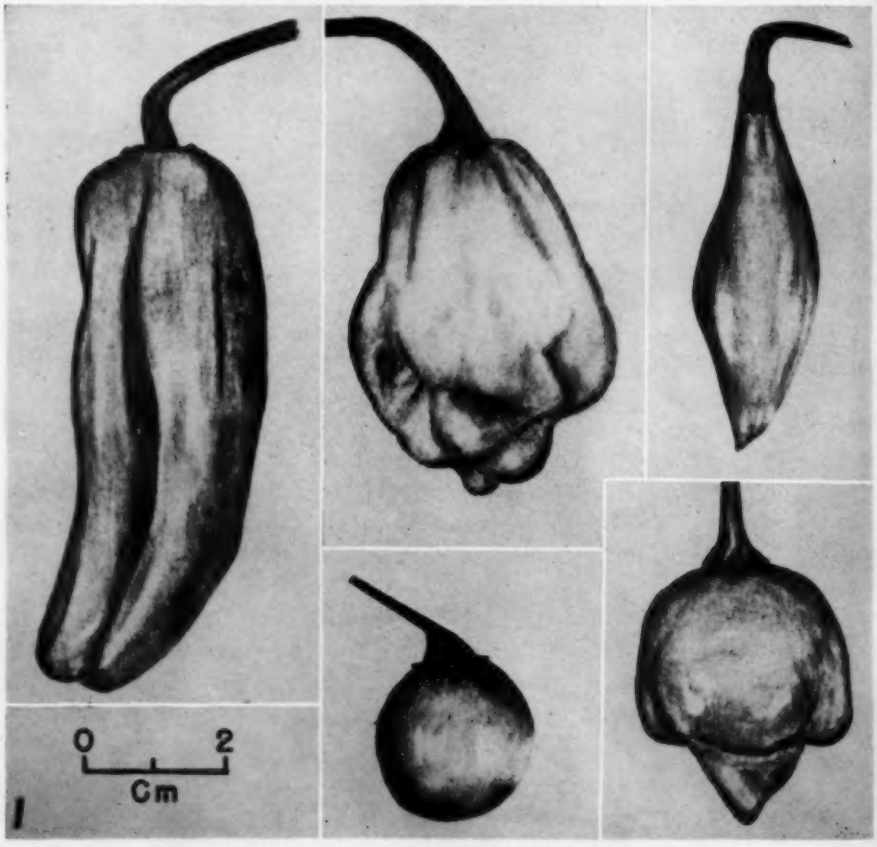


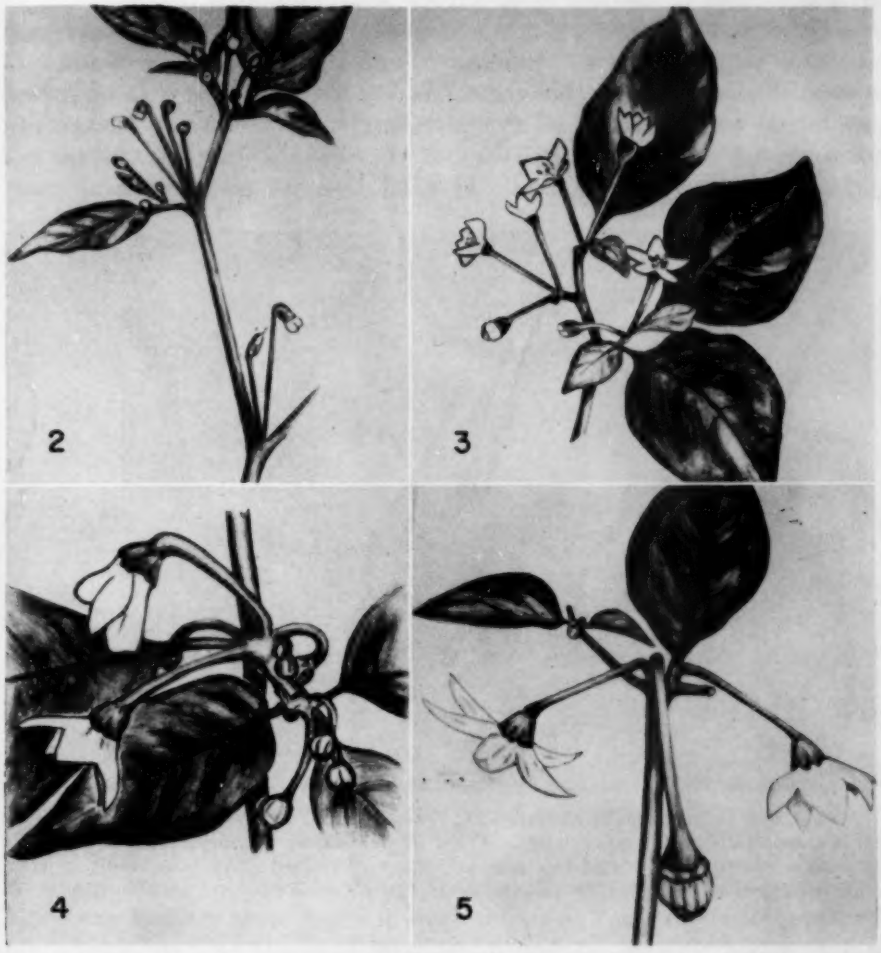
FIG. 1. Fruit of *C. sinense*. Note irregular shape of fruit commonly found in this species.

collections from British Guiana, Ac. 1270 and 1274). Fruits from 1.0 cm. to 12.0 cm. in length, varying from spherical to elongate, smooth or frequently variously wrinkled (fig. 1), orange, yellow, salmon, red, or brown. Seed margins usually wavy, rarely smooth.

It is unfortunate that the earliest name for this American plant appears to be Jacques' *C. sinense* (as "chinense"). The plant shown in his plate, although showing only two pedicels at the nodes is almost identical to some of our collections. Our Ac. 751 (P. I. 157,062) from Lanchow, China, is a

fairly close match and it in turn is almost indistinguishable from a line (Ac. 910) from Costa Rica.

Of the many binomials proposed for cultivated Capsicums in the past century, we can place two in synonym with *C. sinense: C. luteum* Lam.

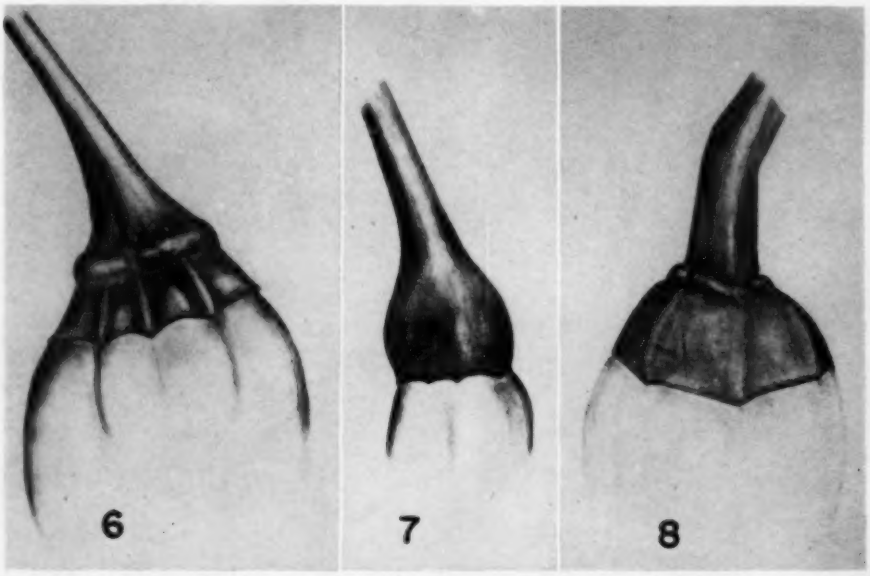


FIGS. 2–5. Pedicel size and position. FIG. 2. Typical slender, nearly vertically oriented pedicels of *C. frutescens*. FIG. 3. An uncommon form of *C. sinense* with nearly straight pedicels. Note the thicker pedicels and lack of vertical orientation as compared with *C. frutescens*. FIGS. 4 and 5. Typical pedicel number and position in *C. sinense*.

Tabl. Enc. 2:26 (no. 2392) 1793 described from India (Shaw and Khan 1928, however, do not list any peppers referable to *C. sinense* from India) and *C. umbilicatum* Vell. Fl. Flum. 2:61. t. 7. 1825 described from Brazil. In all probability *C. sinense* was introduced into Europe shortly after the

discovery of America, but it is impossible to distinguish *C. annuum* and *C. sinense* on the basis of the descriptions given by the early workers.

Capsicum pubescens with its purple corollas and black seeds, and *C. pendulum* with yellow spotted corollas and yellow anthers are readily separated from *C. sinense*. However, the separation of *C. sinense* from *C. frutescens* and *C. annuum* is not so obvious. When *C. frutescens* was recognized as distinct from *C. annuum*, the presence of *C. sinense* was not suspected, and some collections of *C. sinense* were included with *C. frutescens* in our earlier paper (Smith and Heiser 1951). The two, however, can be separated generally on the basis of the pedicels. In *C. frutescens* the pedicels are long, slender (ratio of pedicel length to width is approxi-

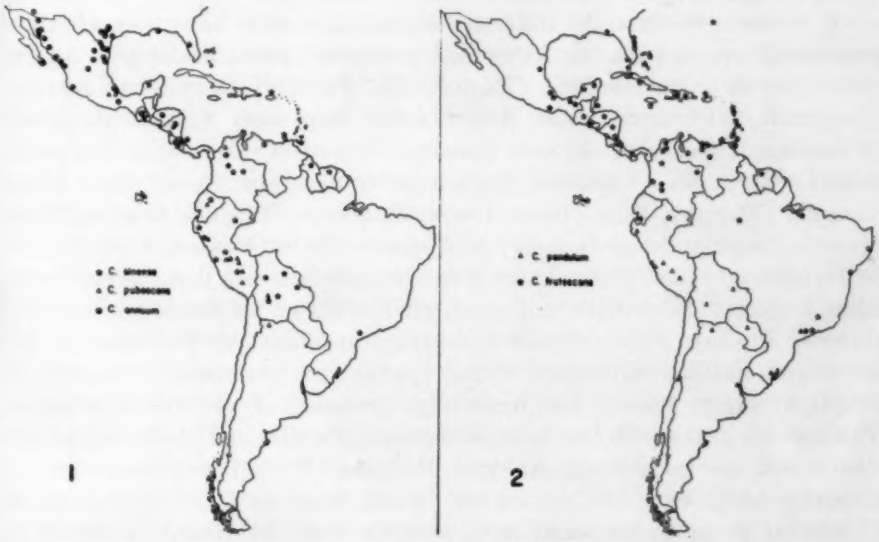


Figs. 6–8. Calyx forms in *C. sinense*, *C. frutescens* and *C. annuum*. Fig. 6. *C. sinense* calyx showing distinctive constriction. Fig. 7. *C. frutescens*. Characteristic smooth calyx of smaller fruited varieties of this species. Fig 8. Wrinkled calyx base resulting from fruit enlargement. This is frequently found in *C. annuum* and occasionally in *C. frutescens*.

mately 1:20), and always strictly erect at anthesis, (fig. 2), whereas in *C. sinense* the pedicels are short to moderately long, thicker, and usually curved or very seldom erect at some of the nodes (figs. 3–5). A second character separating the two species is a distinct circular constriction between the pedicel and calyx which is evident in *C. sinense* when fruit development begins and which is lacking in *C. frutescens*. Occasionally in *C. frutescens* a slight constriction can be seen, but this is due to the enlargement of the fruit, and is in the nature of a wrinkled fold rather than a smooth continuous constriction (figs. 6–8). The corolla lobes in *C. frutescens* are nearly always spreading and frequently recurved whereas in

C. sinense the corolla lobes are slightly or not at all spreading. The number of pedicels at a node in *C. frutescens* is usually two, occasionally three or four, rarely one or five, whereas three to five is the common number in *C. sinense*.

Capsicum sinense is separated from *C. annuum* readily on pedicel number which in *C. annuum* is always one per node (occasionally two at the first flowering node) and in *C. sinense* is three to five. The corolla in *C. annuum* is fairly clear white and in *C. sinense* usually a dull white or a waxy greenish color. The leaf is sometimes broader and more frequently rugose in *C. sinense* than in *C. annuum*. The calyx constriction when present in *C. annuum* is a wrinkled fold due to fruit enlargement rather than a



MAPS 1–2. Distribution of the five cultivated *Capsicum* species. *C. annum* locations are shown for uncultivated forms only. For the other species, localities are shown for all collections and herbarium specimens identified.

distinct circular constriction. Finally, the seed margins are usually wavy in *C. sinense* and are always smooth in *C. annuum*. The most reliable character, however, is the pedicel number.

Genetic relationships. *C. sinense* × *C. frutescens*. A total of 13 crosses involving 7 strains of *C. frutescens* and 12 strains of *C. sinense* were made. Per cent stainable F_1 pollen ranged from 12 to 72. Some F_1 plants produced a small amount of viable seed; most were completely seed-sterile. Thus, in spite of a strong morphological similarity, these two species have a highly developed sterility barrier which effectively keeps them separate.

C. sinense × *C. annuum*. Fourteen different crosses, using 6 *C. annuum* and 13 *C. sinense* strains were made. Per cent stainable F_1 pollen ranged from 1 to 70. One combination, Fresno Chili (*C. annuum*) × Ac. 1432 (*C.*

sinense) produced completely sterile hybrids. The remainder tested produced moderate to abundant seed. Populations of more than 100 F_2 plants each from two partially fertile F_1 plants were grown in the field in the summer of 1954. All F_2 plants were moderately to highly sterile. In spite of the fact that partially viable F_1 hybrids could be obtained, an extensive collection made by the junior author in Costa Rica revealed only two plants that might have been hybrids between *C. sinense* and *C. annuum*. Since Costa Rica is an area of maximum contact between these two species, it appears that hybridization between the two species is rare.

Geographical distribution. Additional information has become available since our previous papers, and a general picture of geographic distribution of the cultivated species can now be drawn (maps 1, 2).

C. sinense. Seeds of 85 different lots of *C. sinense* have been obtained and plants grown from the following countries: United States (St. Augustine, Florida), Puerto Rico (Caguas, Rio Piedras), Mexico (Yucatan), Guatemala, Nicaragua, Costa Rica (Limón, San José, Turrialba), Brazil (Campinas), Surinam, British Guiana, Venezuela (Maracay, Margarita Island), Colombia (Mariquita, Boyacá Prov., Sincelejo, Paicol, Tolú, Une), Ecuador (Patate), Peru (Lima, Piura, Huancayo, Trujillo, Iquitos, Tingo Maria), Bolivia (San Ignacio de Velasco, Todos Santos, Cochabamba, Rurrenabuque), and Chile. There is fairly good evidence that the specimens from Yucatan, Puerto Rico and southern Florida are of fairly recent introduction. In Costa Rica a considerable range in plant and fruit form is encountered, but the cultivation of this species here is almost exclusively by people of negro descent and hence also probably of recent introduction. This species appears to be the most commonly cultivated and most widely distributed species in South America. Bukasov (1930) listed two centers of diversity for *C. annuum*, Mexico and Brazil. Since he failed to distinguish *C. sinense* from *C. annuum*, it is possible that the Brazilian forms he studied belong to *C. sinense*, but as yet, we have not seen enough material from Brazil to verify this claim. While we have not yet seen forms of *C. sinense* which we believe to be wild types, some of the smallest fruited types which we have encountered came from British Guiana.

Capsicum annuum L. The uncultivated, small fruited forms of this species are widely distributed from the southern United States (Louisiana, Texas, Arizona) to northern South America. In recent literature these have been called *C. baccatum* L., *C. frutescens* var. *baccatum* (L.) Irish, *C. annuum* var. *baccatum* (L.) OK., *C. annuum* var. *minus* (Fingerh.) Shinners and is variously known as *chili piquín, chiltepín, chiltepec, chilpaya* or *chile de monte* in Mexico and Central America. For the present, we are referring all these small spherical-fruited sorts to *C. annuum* var. *baccatum* (L.) OK. This variety is not mentioned by Hunziker (1950)

among the wild peppers of Argentina and Paraguay, and material which we have seen from South America labeled *C. baccatum* is mostly referable to *C. microcarpum* Cav. We have grown some 40 strains of this variety from throughout most of its range, and although it is less variable than the cultivated taxon, it nevertheless displays considerable diversity.

The greatest diversity in the cultivated forms of *C. annuum* occurs in Central Mexico with a secondary center in Guatemala. South of Guatemala collections of this species drop off sharply. We have obtained a few cultivated forms from Trinidad, Brazil, Peru, Argentina, Chile, and Bolivia, most of them from experimental stations or centers of large European populations. These forms were usually recognizable American or European commercial varieties or similar to Mexican strains. While the possibility of the movement of *C. annuum* into South America in pre-Columbian times cannot be excluded, it appears then that recent introductions can account for the presence of cultivated forms of *C. annuum* in South America. We cannot regard reports of these species in literature as reliable since neither *Capsicum pendulum* or *Capsicum sinense* were recognized in earlier times. Virtually all the varieties now in cultivation in the United States and Europe belong to *Capsicum annuum*.

C. frutescens L. Our collections and the herbarium material studied place the range of this species from southern United States (coastal areas of Louisiana, Alabama and Florida) throughout all the Caribbean Islands, the Bahama Islands and Bermuda, and from the State of Vera Cruz in Mexico, south along the tropical parts of Mexico and through all of Central America into northern and eastern South America. This species is found throughout this area as a weed or wild plant, and the larger fruited cultivated material is found largely from southern Mexico to Costa Rica. As a cultivated plant, this species is much less variable and much more restricted in distribution than the other cultivated species. A statement by us (1951) that it is found in the native agriculture of South America was based on material that we now classify as *C. sinense*. This species is also very widely distributed in the Pacific Islands. Herbarium specimens from Truk, Hawaii, Tonga, Fiji, Samoa, Guam, Tahiti, Hainan, and Benguey Islands carry notations indicating that the plants were not cultivated. This plant is widely cultivated in Malasia, India, and Africa and is largely absent from temperate zone countries probably because of the long growing season required to mature fruits. The senior author has seen plants growing wild in Guadalcanal, Solomon Islands, and Efate in the New Herbrides. In the uncultivated state, *C. frutescens* is definitely restricted to an essentially tropical habitat. Because of its very wide distribution, no conclusions as to its probable center of origin can be drawn at this time.

C. pendulum Willd. This species has never been found outside of South

America except for one collection from Hawaii and one from Costa Rica, both of which were undoubtedly recent introductions. It is apparently less common and more restricted in area than *C. sinense*. We have obtained material or seen herbarium material from southern Brazil, Ecuador, Peru, Bolivia, Paraguay, and Chile. The greatest diversity is found in Ecuador, Peru, and northern Chile. *Capsicum microcarpum*, a wild species closely resembling *C. pendulum* forms fertile hybrids with it which suggests that it may be the wild progenitor. Our material of *C. microcarpum* has been obtained from Bolivia, and its distribution is listed by Hunziker (1950) as Paraguay, southern Brazil, southeastern Bolivia, and northern Argentina.

C. pubescens R. & P. A montane or highland species, *C. pubescens* is found from Mexico City south to Bolivia. The species is rather rare in Mexico and Central America and much less variable than the material from the Andes. No wild species closely related to *C. pubescens* is known at present.

SUMMARY

1. A previously unrecognized cultivated pepper, *Capsicum sinense* Jacq., is reported from Central and South America. This species is most readily distinguished by the 3–5 flowers at each node, the declinate pedicels, and the circular constriction at the base of the calyx in fruit.

2. Crosses between *C. sinense* and both *C. annuum* and *C. frutescens*, to which it appears most closely related, generally give hybrids showing some impairment of fertility. Notes on the geographical distribution of the other cultivated peppers, *C. annuum*, *C. frutescens*, *C. pendulum*, and *C. pubescens*, are also presented.

Department of Vegetable Crops, University of California
Davis, California
Department of Botany, Indiana University
Bloomington, Indiana

Literature Cited

Bukasov, S. M. 1930. The cultivated plants of Mexico, Guatemala and Colombia. Bul. Appl. Bot., Genetics and Plant Breeding. Suppl. **47**: 261–273. (In Russian. Translated by Mrs. N. P. Tarassuk)

Erwin, A. T. 1949. An interesting Guatemalan chilli (*Capsicum Guatemalense* Bitt.). Iowa State Coll. Res. Bul. **371**: 612–615.

Heiser, Charles B., Jr. and Smith, Paul G. 1953. The cultivated *Capsicum* peppers. Econ. Bot. **7**: 214–227.

Hunziker, Armando T. 1950. Estudios sobre *Solanaceae*. I. Sinopsis de las especies silvestres de *Capsicum* de Argentina y Paraguay. Darwiniana **9**: 225–247.

Shaw, F. J. F. & Khan, S. A. R. K. 1928. Studies in Indian chillies. (1) The types of Capsicum. Mem. Dept. Agric. India, Ser. **16**: 59–82.

Smith, Paul G. & Heiser, Charles B. Jr. 1951. Taxonomic and genetic studies on the cultivated peppers, *Capsicum annuum* L. and *C. frutescens* L. Am. Jour Bot. **39**: 362–368.

Standley, Paul C. 1928. Flora of the Panama Canal Zone. Contr. U.S. National Herb. Vol. **27**.

BULLETIN OF THE TORREY BOTANICAL CLUB
VOL. 84, NO. 6, PP. 421–423 DECEMBER, 1957

NEW NAMES IN ARGYTHAMNIA SUBGENUS DITAXIS

JOHN INGRAM

In 1950, I began a taxonomic revision of all the North American species of *Argythamnia* P. Browne subgenus *Ditaxis* (Vahl) Croizat, Jour. Arnold Arb. 26: 191. 1945. Further investigation of anatomy and external morphology of these taxa from North and South America has led to a sectional revision of subgenus *Ditaxis*. Although this treatment will be published in the near future, certain name changes should be recorded at this time.

The letters used to indicate the herbaria where specimens are cited are those recommended by Lanjouw and Stafleu, The herbaria of the world, second edition, 1954. I am indebted to the curators of the various herbaria who so generously made their specimens available for this study.

Argythamnia simulans Ingram, sp. nov. Perennis herbacea, caulibus ad 5.5 dm. longis, pilis strigoso-malpighiaceis; foliis sessilibus, lanceolatis, ovato-lanceolatis, ellipiticis vel oblanceolatis, 3–6 cm. longis, 7–20 mm. latis, acutis vel obtusis; racemis 4–10 cm. longis; plantis monoecis vel dioeceis; floribus masculis: sepalis lanceolatis vel oblongo-lanceolatis, 3–4 mm. longis, acutis, extus pilis malpighiaceis, intus glabris; petalis ovatis ad cordatis, 3–5 mm. longis, extus pilis malpighiaceis, intus glabris; glandulis rectangularis; staminibus 7 vel 8, biseriatis; floribus femineis: sepalis ovatis, 4.5–6 mm. longis, extus pilis malphighiaceis, acutis; petalis nullis, punctiformis vel lanceolatis; glandulis rectangularis; ovario subgloboso, piloso; stylis bifidis; stigmatibus dilatis; capsulis subglobosis, ca. 5 mm. latis, ca. 4 mm. longis; seminibus subglobosis, apiculatis, brunneis.

Perennial herb; stems to 5.5 dm. long, grooved, mostly branched from a woody base, with malpighiaceously strigose hairs; leaves sessile, lanceolate, ovate-lanceolate, ovate, elliptical or oblanceolate, 3–6 cm. long, 7–20 mm. wide, with malpighiaceous hairs on both sides, the apex acute or obtuse, the margin entire; inflorescences racemose, 4–10 cm. long; bracts lanceolate, 2–3 mm. long, with malpighiaceous hairs outside and along the margin, glabrous inside, the apex acute, the margin entire; plants dioecious or monoecious; staminate flowers: sepals lanceolate or oblong-lanceolate, 2–3 mm. long, with malpighiaceous hairs outside, glabrous inside, the apex acute, the margin entire; petals ovate to cordate, 3–5 mm. long, the claws free from the androphore, with few malpighiaceous hairs outside, glabrous inside, the margin entire to subentire; glands wider than long, adnate to base of androphore; androphore stout; stamens 7 or 8 in two whorls, 5 in the lower whorl; carpellate flowers: sepals ovate, 4.5–6 mm. long, with malpighiaceous hairs outside, glabrous or with an occasional malpighiaceous hair inside, the apex acute, the margin entire; petals frequently wanting, but when present, punctiform to lanceolate; glands wider than long, thin, glabrous; ovary with malpighiaceous hairs; styles thick, united at base, spreading, bifid ca. ½ the free part, pilose; stigmas flattened and dilated; capsules subglobose, ca. 5 mm. wide, ca. 4 mm. long, slightly hairy; seeds

subglobose, ca. 3 mm. long, ca. 4 mm. wide, apiculate, faintly reticulate, brown.

TYPE: Frequent in shady places on limestone hill, ½ mile southwest of Ingram, Kerr County, Texas, 29 April 1946, *Cory 51850* (UC 735372; Isotype: US).

DISTRIBUTION: South central Texas.

REPRESENTATIVE SPECIMENS STUDIED: Bexar Co.: limestone hills near Bracken, *Groth 56* (F, GH, MO, NY). Blanco Co.: along ledges of limestone bluff, Blanco River, near Blanco, *E. J. Palmer 33911* (GH, MO, NY). Edwards Co.: Ranch Experiment Station, pasture G, *Cory 5004* (GH). Kendall Co.: Spanish Pass, *Cory 19307* (GH). Kerr Co.: near Kerrville, *Heller 1648* (CU, GH, MO, NY, UC, US); 12 miles southwest of Kerrville, *Cory 23481* (GH). Sutton Co.: Schoolhouse Hill, Sonora, *Cory 40159* (A). Travis Co.: near Austin, *York 391* (MO); Austin, *Hall 577* (F, MO, NY, US). Williamson Co.: near Leander, *Lundell & Lundell 9020* (GH, NY).

Argythamnia simulans is closely related to *A. aphoroides* Muell. Arg. and *A. mercurialina* (Nutt.) Muell. Arg. The following key will serve to separate these three species:

Glands of the carpellate flowers linear, pubescent or glabrous; glands of the staminate flowers linear, free from the androphore.
- Glands of both flowers glabrous ..... *A. mercurialina* var. *mercurialina.*
- Glands of both flowers pubescent ..... *A. mercurialina* var. *pilosissima.*

Glands of the carpellate flowers wider than long; glands of the staminate flowers rectangular, adnate to the base of androphore.
- Staminate petals obovate-cuneate; stamens 10; androphore slender; carpellate glands thick; styles erect ..... *A. aphoroides.*
- Staminate petals ovate to cordate; stamens 7 or 8; androphore stout; carpellate glands thin; styles spreading ..... *A. simulans.*

Argythamnia argyraea Cory, Madroño 8: 91. 1945. All the collections of this species which I have seen indicate that this species is strictly dioecious. At the time Cory described this species, he had only carpellate specimens, however, as he has indicated, Dr. Munz accompanied him on the field trip when the type collection was made. Dr. Munz collected a sheet of material which is entirely staminate (15 miles west of Cotula, La Salle County, Texas, *Munz 13325*, POM) and appears to belong with the species described by Cory as *A. argyraea.* The staminate flower is described here to supplement Cory's description:

Inflorescence to 2 cm. long; staminate flowers: sepals linear-lanceolate, ca. 3–4 mm. long, with malpighiaceous hairs outside, glabrous inside, the apex acute, the margin entire; petals linear-lanceolate, 3–5 mm. long, free from the androphore, with malpighiaceous hairs outside, glabrous inside, the margin entire; glands minute, linear, erect, free from the androphore; androphore ca. 2–3 mm. long; stamens 10 in two whorls of 5; staminodia 5, punctiform.

Argythamnia acaulis (Herter) Ingram, comb. nov. *Ditaxis acaulis* Herter, Anal. Mus. Nac. Montevideo, ser. 2, I: 79. 1911.

Argythamnia cuneifolia (Pax & K. Hoffmann) Ingram, comb. nov.

Ditaxis cuneifolia Pax & K. Hoffmann, Pflanzenreich IV. 147(17): 180. 1924.

Argythamnia haitiensis (Urban) Ingram, comb. nov. *Ditaxis haitiensis* Urban, Arkiv För Botanik 20A(15): 58. 1926.

Argythamnia Jablonszkyana (Pax & K. Hoffmann) Ingram, comb. nov. *Ditaxis Jablonszkyana* Pax & K. Hoffmann, Pflanzenreich IV. 147(6): 60. 1912.

Argythamnia malpighipila (Hicken) Ingram, comb. nov. *Croton? malpighipilus* Hicken, Physis 2: 106. 1916; *Ditaxis malpighipila* (Hicken) L. C. Wheeler, Contrib. Gray Herb. 124: 39. 1939.

Argythamnia rhizantha (Pax & K. Hoffmann) Ingram, comb. nov. *Ditaxis rhizantha* Pax & K. Hoffmann, Pflanzenreich IV. 147(6): 77. 1912.

Argythamnia rosularis (Pax & K. Hoffmann) Ingram, comb. nov. *Ditaxis rosularis* Pax & K. Hoffmann, Pflanzenreich IV. 147(6): 76. 1912.

Argythamnia salina (Pax & K. Hoffmann) Ingram, comb. nov. *Ditaxis salina* Pax & K. Hoffmann, Pflanzenreich IV. 147(6): 72. 1912.

Argythamnia Sellowiana (Pax & K. Hoffmann) Ingram, comb. nov. *Ditaxis Sellowiana* Pax & K. Hoffmann, Pflanzenreich IV. 147(6): 77. 1912.

SUMMARY

1. All taxa discussed here belong to *Argythamnia* P. Browne subgenus *Ditaxis* (Vahl) Croizat.

2. One new species has been described; the staminate flower of *Argythamnia argyraea* Cory has been described; and, nine species names have been transferred from *Ditaxis* to *Argythamnia*.

L. H. Bailey Hortorium, Cornell University,
Ithaca, New York

BULLETIN OF THE TORREY BOTANICAL CLUB
VOL. 84, NO. 6, PP. 424–428 DECEMBER, 1957

GANODERMA LUCIDUM, A PARASITE OF SHADE TREES

P. P. PIRONE[1]

Some investigators believe that *Ganoderma lucidum* (Leys.) Karst. (*Polyporous lucidus*) is a saprophyte of hardwood and coniferous trees (Boyce 1938). This conclusion is based largely on the fact that the reddish, varnish- or lacquer-like coated conks are commonly observed on dead trees and timber. However, a number of reports have appeared in the literature (Reichert & Avizohar 1939, Bagchee & Bakshi 1950, Lohway 1942, Urquart 1945) which suggest that Ganodermas are parasites. The most recent one (Nickell 1952) suggests that a species of *Ganoderma* was involved in the death of a large sassafras at the Brooklyn Botanic Garden.

During the 1956 growing season the author had occasion to examine more than three hundred dead or dying shade trees, principally Norway maples (*Acer platanoides*), planted along New York City streets. All these trees were alleged to have been killed or damaged by natural gas escaping from leaking mains.

During the late summer of 1957 he examined 40 additional shade trees, mostly Norway maples and red or swamp maples (*A. rubrum*), growing along the streets in Atlantic Highlands, New Jersey. All of these trees were also alleged to have been killed or damaged by escaping gas.

In the course of diagnosing for the cause of the trees' death, on nearly 20 per cent of the trees the author observed the typical fruiting bodies of *Ganoderma lucidum* emerging either from the trunk base of affected trees or from their roots.

The majority of the trees exhibiting this fungus had been dead anywhere from a few weeks to two years or more.

Ganoderma conks were observed, however, on a considerable number of trees which were still alive. In the New Jersey survey involving 40 trees, for example, five red maples and one Norway maple were still very much alive but had well-developed conks on their trunk base or roots. In every case the branches above that part of the trunk invaded by *Ganoderma* either had undersized leaves or were completely dead. The branches above the uninvaded side of the trunk had normal foliage.

This observation is contrary to that reported by some pathologists who claim that *Ganoderma lucidum* (*Polyporous lucidus*) only develops on dead trees.

Several cases were studied in which the roots, trunk base and branches on the street side, nearest the natural gas leak, were normal. However, the

[1] Thanks are due to Miss Biruta Eimanis, formerly my research assistant, for help with this problem.

FIG. 1. The author is examining a 15-inch DBH red maple which has *Ganoderma lucidum* fruiting at the trunk base on the side with dead branches. The branches on the street side are alive.

FIG. 2. The author is examining conks of *Ganoderma lucidum* at the base of a 10-inch DBH Norway maple. The leaves in the foreground taken from the street side of this tree are normal in size and color. The branches directly above the Ganoderma-invaded side were leafless and dead.

roots, trunk base and branches on the opposite or sidewalk side of the same trees, farthest from the gas leak, were dead (fig. 1). The roots and trunk base on the dead side were invaded by *Ganoderma lucidum* as was readily evident from the numerous conks (fig. 2).

Cutting into the bark and sapwood of partially infected red and Norway maples revealed a sharp line of demarcation (fig. 3) between invaded and

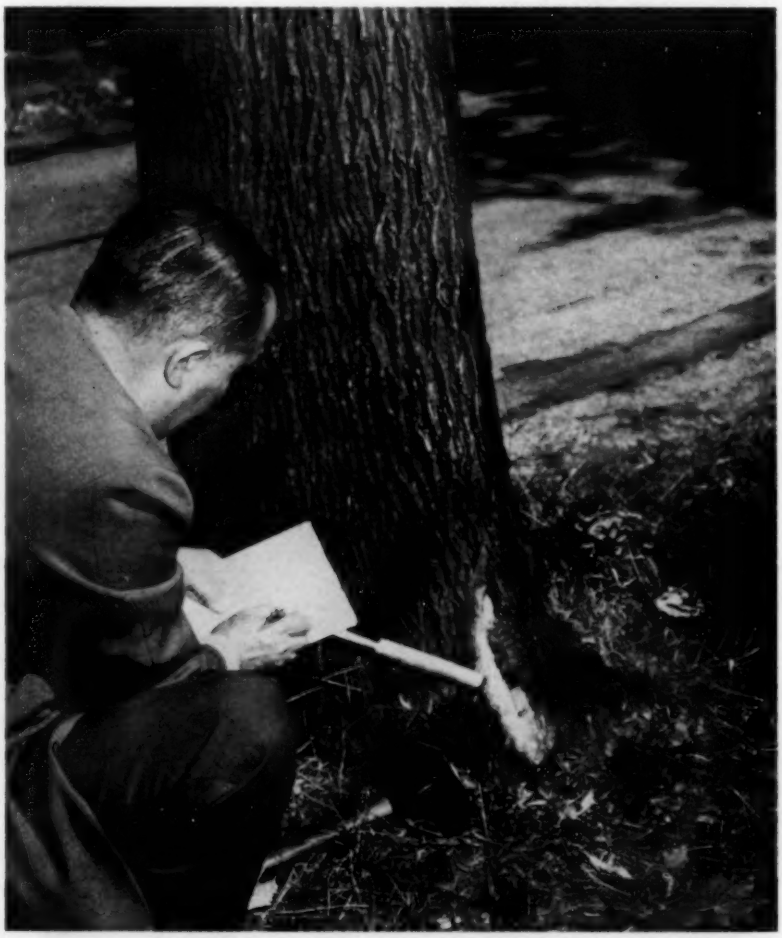


FIG. 3. The bark at the base of this Ganoderma-infected Norway maple has been cut away to show the zone where fungus-infected and healthy bark and sapwood meet. Note Ganoderma fruiting from roots in background.

non-invaded tissue. Bark and sapwood chips collected from more than 20 of these trees were subjected to the standard tissue planting isolation technique in the laboratory and always yielded pure cultures of the *Ganoderma* fungus (fig. 4).

Several of these isolates were inoculated into the base of 3-year old Norway maple seedlings. Within six months the bark and sapwood were invaded by the fungus which was then recovered from infected bark and sapwood several inches above and below the point of inoculation. These tests suggested that *Ganoderma* can invade live tree tissue.

In a second series of tests two large, fresh conks of *Ganoderma lucidum* collected from the base of a dead Norway maple in Brooklyn, New York on August 1956 were chopped into squares a half inch or so, and worked into the soil around the roots of 4 three-year old Norway maples growing in pots in a greenhouse. Four trees of the same age and variety were not given the chopped fungus tissue but were held as controls.

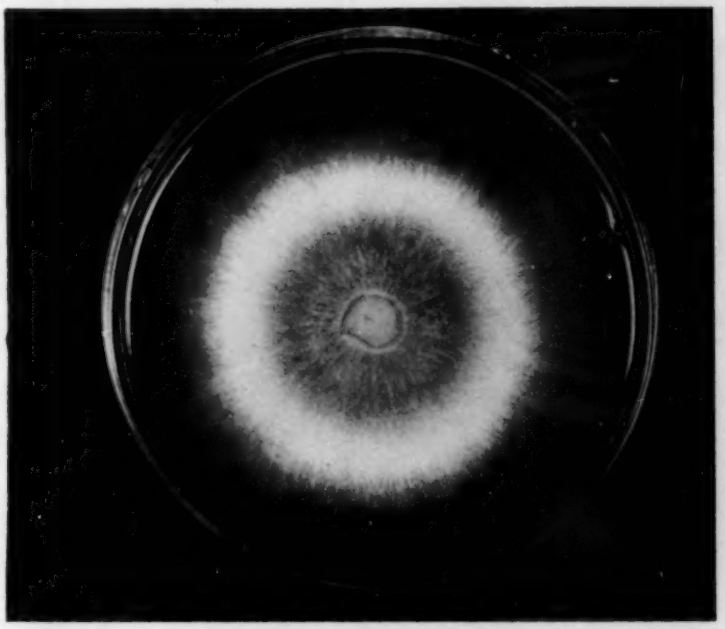


FIG. 4. A three-weeks old culture of *Ganoderma lucidum* on potato dextrose agar.

Two of the four maples receiving the chopped fungus failed to leaf out and were dead in the spring of 1957. Tissue planting isolations from the inner bark and sapwood of these trees yielded pure cultures of *Ganoderma lucidum*.

The two remaining treated trees showed sparse, undersized foliage in early spring and summer and finally wilted and died by early August of 1957. Tissue plantings from dead roots and the lower trunk of these trees also yielded pure cultures of *Ganoderma*.

The four control trees continued to grow normally as late as October 1, 1957, when this article was written.

On the basis of the present laboratory and greenhouse tests and the ob-

servations made in the past two years on hundreds of shade trees, the author feels that *Ganoderma lucidum*, like *Verticillium albo-atrum* and *Armillaria mellea*, should be considered an important parasite of shade trees growing along city streets.

THE NEW YORK BOTANICAL GARDEN
NEW YORK 58, N. Y.

Literature Cited

Boyce, J. W. 1938. Forest Pathology, New York.

Reichert, I. & Avizohar, Zehara. 1939. An anatomical study of the fruit body of the wood-rotting fungus *Ganoderma lucidum*. Palest. Jour. Bot. R-Ser II. 251–288.

Bagchee, K. & Bakshi, B. K. 1950. Some fungi as wound parasites on Indian trees. Indian For. **76** (6).

Lohway, H. 1942. Zum Sterben der Baume in Lainzer Tiergarten. Zbl. ges. Forstw. **68**: 179–197.

Urquart, D. H. 1945. Report Dept. Agr. Gold Coast for year 1944–45.

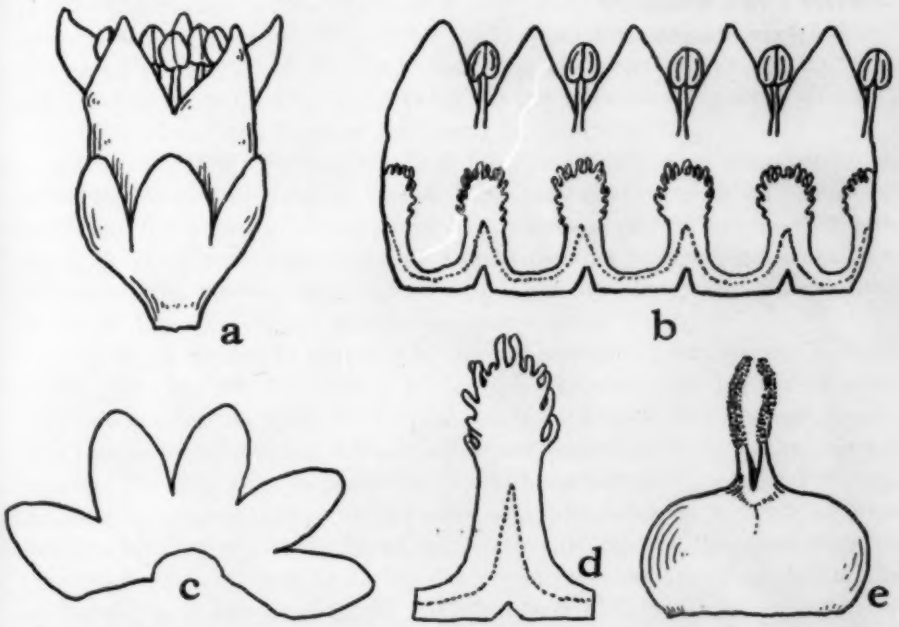
Nickell, L. G. 1952. A species of *Ganoderma* probably pathogenic to sassafras in New York. Pl. Dis. Reptr. **36** (1): 28–29.

BULLETIN OF THE TORREY BOTANICAL CLUB
VOL. 84, NO. 6, PP. 429–430 DECEMBER, 1957

A NEW CUSCUTA FROM SOUTH AFRICA

T. G. YUNCKER

Cuscuta rhodesiana Yuncker sp. nov. Caules tenues. Flores sessiles 5-divisi circ. 2.5 mm longi a basi ad corollae sinum. Calyx brevior quam corolla, alte divisus, lobi ovati vel oblongi obtusi. Corollae lobi ovati acuti tubo campanulato breviores. Scalae oblongae breviores quam tubus fimbriatae circ. cacumen. Stigmata longiora quam styli. Capsula depresso-globosa circumscissilis.



Cuscuta rhodesiana Yuncker sp. nov. a. Flower. b. Opened corolla showing interior view. c. Opened calyx. d. Detail of infrastamineal scale. e. Capsule. All figures enlarged.

Stems slender. Flowers sessile, 5-parted, in few-flowered (4–10) glomerules, about 2.5 mm long from the base to the corolla sinuses. Calyx somewhat more fleshy than the corolla, reaching to the middle or upper third of the corolla tube, deeply divided, the lobes variable in size and shape, ovate or oblong, obtuse, scarcely overlapping at the base, subcarinately thickened. Corolla white and submembranous, campanulate, becoming urceolate about the maturing capsule and somewhat saccate toward the base beneath the lobes, the lobes ovate, acute, about three-fourths as long as the tube, somewhat fleshy and slightly papillate toward the upright to spreading tips. Stamens shorter than the corolla lobes, the ovoid anthers shorter than the

slightly subulate filaments. Scales oblong, scarcely reaching the base of the filaments, fringed about the upper part, bridged low. Stigmas cylindrical, about twice as long as the subulate styles, both together longer than the depressed-ovoid ovary. Capsule depressed-globose, easily and widely circumscissile, enveloped by the withered corolla. Seeds ovoid-globose, the hilum oblong, suboblique, the embryo slender, with about 1½ coils.

Type: Rhodesia: Ndola, swamp of Itawa River, July 13, 1932, R. G. N. Young 53 (British Museum of Natural History.)

The campanulate, quickly urceolate corolla, shape of calyx and corolla lobes, oblong scales and short styles characterize this species. It bears some resemblance to *C. epithymum* Murr. but differs in several characters, nor is it to be confused with *C. brevistyla* Braun from which it is readily distinguishable.

DEPAUW UNIVERSITY
GREENCASTLE, INDIANA

BULLETIN OF THE TORREY BOTANICAL CLUB
VOL. 84, NO. 6, PP. 431–441 DECEMBER, 1957

OIL DROPS AND DE BARY "BUBBLES" IN ASCOSPORES

B. O. DODGE

Mycologists who have studied groups of Ascomycetes have usually included oil drops present in ascospores along with other spore characters of a species. If no distinct droplets appear in the spores this fact is ordinarily not mentioned. Boudier, in his Icones (1905–1910), beautifully illustrated ascospores with one or two oil drops in many species of Discomycetes. Rehm (1896) also regularly considered such droplets in ascospores as a diagnostic feature. Seaver, more recently (1928, 1951), pictured or mentioned oil drops in dozens of species of Discomycetes. This character is specific and not generic. For example, Seaver, covering the genus *Paxina*, reported oil drops present in 13 out of 14 species he placed in this genus.

De Bary (1884) pointed out that fatty substances may also appear as numerous small, yet distinct, bodies. They may also occur in an emulsified condition. Fatty matters in spores of *Neurospora* appear to be stored in both ways. A very high percentage of the ascospores of *Lachnea abundans*, however, show two very distinct oil droplets when the spores are mounted in water. These two types will be considered later.

Following his brief comments on the oil content of ascospores, de Bary (1866, 1884) continued with a paragraph reporting the results of some experiments dealing with the air and water content of the ripe ascospores. The 1884 edition covering this subject is essentially the same as the original edition. We may then believe that he still supported his original theory. Apparently contemporary mycologists and physiologists as well as later well-known students of the fungi, have either overlooked this paragraph or ignored it without comment. In any event, we are inserting below the paragraph as it appeared in the 1887 translation:

"The protoplasm of the spore in the young state is rich in water and when dry absorbs water rapidly from its environment. A spore lying in water appears under the microscope to be filled with it to turgescence. As it loses water it contracts, and if the wall is thin the membrane either sinks in irregularly or forms definite folds; round or ovoid spores take, therefore, the shape of a concave-convex lens, the edges of which are often bent over toward each other, and the spore has thus the form of a boat. Thick-walled spores do not change their form in drying, or change it but little. In many cases, an air bubble is formed inside the protoplasm as it parts with water, as in *Peziza abietina*, *P. melaena*, in *Sordaria*, etc. This is due to the fact that air, that is to say, some gas, is dissolved in the contents of the fresh

turgescent spore and is set free as soon as the quantity of water is brought down to a certain limit. The same result is produced if the spore in water is exposed to the influence of reagents like alcohol, glycerine or sulphuric acid which have the power of extracting fluids; the air bubble disappears when water replaces these agents."

De Bary seems not to have illustrated the bodies which he described so assuredly as air bubbles. Shear and Dodge (1927) published photographs of asci of three species of *Neurospora*. Some of the spores in each cluster of asci contained such bodies, but they made no comment on them. Faull (1930), however, in figure 1, F, gives us an excellent picture of a spore containing a body which she called an oil drop or oil globule. She had evidently not seen de Bary's discussion on such bodies, and she had overlooked the illustrations by Shear and Dodge.

Ninety years after de Bary had described this interesting phenomenon, Ingold (1956) gives us the results of his experiments working with *Sordaria fimicola*, *Pleurage curvicolla* and *Hypoxylon fuscum*. Ingold states that the separation of a gas phase in the formation of a gas bubble "is an invariable concomitant of drying." He suggests further that the "gas bubble" may originate within the spore just as it does during spore discharge in the annulus cell of a drying fern sporangium. This postulate is highly interesting and should be investigated further.

De Bary seems not to have discovered what, if anything, comes into view as the bubble, or whatever it is, gradually disappears following immersion of the spore in water. Ingold observed that if one examines a dry spore of a *Sordaria* a round paler zone in the center is always seen. Immersed in water the zone quickly appears as a "gas bubble" which then disappears within a few minutes. This behavior convinced Ingold that the gas phase is presumably water vapor. Neither de Bary nor Ingold reported the presence of typical oil drops or oil globules in spores of *Sordaria* and other species they studied. No one has mentioned, so far as has come to our attention, oil drops in normal spores of *Neurospora*. Oil or other fatty matters, however, must be present either as numbers of minute bodies, or in "emulsionized" form. See de Bary, the 1887 translation, also our own tests for oil in spores of *Neurospora* mentioned later. On the basis of our studies of *Neurospora* and other ascomycetes, we can accept, in principle, the view that formation of these "bubbles" involves at least two processes, alternate drying and wetting.

As de Bary pointed out, any drying reagent such as alcohol or glycerine, may be used or the spores may first be suspended in water, then left to air-dry. We have used for many years the Shear Mounting Fluid, SMF, for making more or less permanent slide mounts. This consists of 300 cc. of 2% potassium acetate, 120 cc glycerine, 180 cc. alcohol.

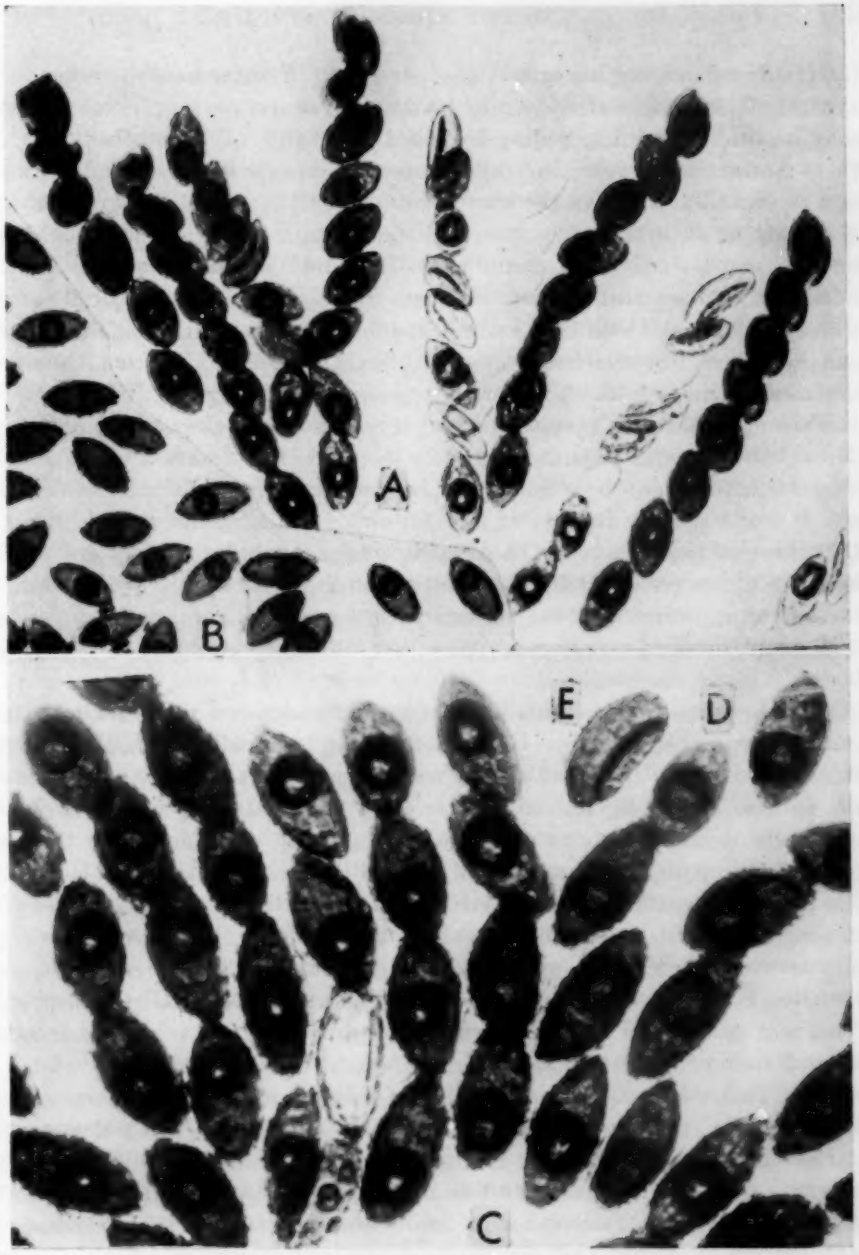


FIG. 1. *Neurospora tetrasperma.* All asci and spores had been immersed in the SMF. A. Part of a rosette of asci originally heterozygous, *AaEe*, for mating type *Aa* and *Ee* for 8-sporedness. Many spores contain one dBb each; other spores have collapsed due to the drying effects of the SMF reagent in which this rosette was mounted. Note that no collapsed spore contains a "bubble". B. From the same type of culture as A, except here the spores were from a spore-print and so were scattered about when mounted in the SMF. All these spores lie flat, having no doubt been pressed down by the cover-glass. The dBb in some spores is off-center. Such spores, if given space to move about, would have come to rest in an erect position. C. Part of a rosette of wild type asci. Except for a few spores that collapsed, each spore shows a single dBb. D. A spore with its dBb off-center. E. A collapsed spore. See text for further comment.

If one mounts mature spores of *Neurospora* in water he does not see any typical oil droplets, but there may be many granules present. Some of these may be the rib-forming bodies described by Dodge (1957); others may be fatty matters which some authors believe may represent stored food. If, now, one replaces the water in the mount with the SMF, it will be found that in a minute or so many ascospores will be forming conspicuous "bubbles", one in each spore. In such mounts the "bubbles" appear so quickly that it is not easy to see just where they came from. By diluting the SMF with water, a dilution (about 30%) can be made of such strength that the process can be followed very easily. Ingold (1956) reported that the "bubble" begins as a tiny one which may require half an hour to reach full size. With full strength SMF we have found that it requires only about a minute or so. These bubbles could consist of "some gas" as de Bary stated; or, as Ingold suggested, they may be a gas phase in the form of a bubble in which the gas is water vapor. Results of the following experiments would indicate that this question as to what these intracellular "bubbles" really are should be given a new look and further study. For the present at least, not knowing the true nature of these curious bodies, we shall refer to them as the dBb which the reader may translate either "de Bary bubbles" or "de Bary bodies", as he chooses.

It was stated above that ascospores of *Neurospora* mounted in water show no typical oil droplets. If the water is replaced with the SMF reagent, "de Bary bubbles" such as are shown in figure 1, A-E, quickly appear in the spores. If the drying reagent is then replaced with water, the dBb gradually decrease in size and finally disappear. This could be the end result so far as de Bary and Ingold carried on their experiments. However, if a particular spore is watched carefully as the dBb is gradually decreasing in size, there will be seen to appear, faintly at first, then more distinctly, one or two round bodies which we would all call oil drops. So, we would then see a spore containing the last vestige of the original dBb separate from and in addition to newly formed "oil drops" which are not characteristic of living normal spores of *Neurospora*. Finally, only the oil globules remain. This alternation of phases can be demonstrated in the reverse order. For example, start with spores, each with one or two oil globules still immersed in water. This water is replaced with the SMF reagent. In a short time the tiny dBb reappear, and as they get larger and larger it is the oil drops that begin to fade out and finally disappear altogether, at least as well defined oil drops. One can easily prove that ascospores of *Neurospora* do not normally and regularly contain typical oil drops, yet be rich in oil or other fatty matters. Take some perithecia from a culture eight or ten days old and make a squash mount of them in the S III solution. One will find a perithecium with a dozen or more asci with spores in various stages

of maturity. One ascus will have just delimited its spores while others may contain four dark-colored mature spores. Other asci will contain spores in intermediate stages of maturity. Up to the time of rib-formation all the contents of each spore will have been stained red, not just portions confined to oil drops. By adding SMF to these mounts they can be preserved, at least for some weeks.

Oil drops and dBb in a *Lachnea*. Other experiments were carried out using a little Discomycete, *Lachnea* (*Patella*) *abundans*. Dodge (1922) described how this species could be readily cultured. The dichotymously branched conidiophores produce the botryose conidia which serve as a good diagnostic character. A very striking feature is the long slender ascus with eight spores, each spore containing two very distinct oil droplets. Occasionally a spore may contain only one. The spores are hyaline but their walls are rather rigid.

While discarding a number of old slide-mounts of various fungi, it was noticed that one slide was labeled "October 1938, *Lachnea abundans*". This slide is still in perfect condition. The SMF had been used in preparing the mount. The interesting thing is that practically every ascospore contained a single dBb. Fortunately Dr. J. W. Groves was able to send us a fresh culture. It has proved to be most excellent material in many ways.

We continued to use the SMF as usual as a drying agent, supplementing this with a saturated solution of Sudan III in alcohol, this not only as a test for oil, but also as a drying agent at the same time. Small fragments of ascocarps were crushed in water under the cover-glass. Scores of asci showed that each ascus had eight spores and, as stated above, each spore had two oil globules, but no dBb. When the water was replaced by the SMF an intracellular dBb soon appeared in each spore. The most interesting thing that happened, but not at first realized, was that as the dBb was *forming*, the *two* oil drops were gradually *fading* away and, as distinct oil drops, they finally disappeared, leaving only the beautiful little dBb, *one* in each spore.

Reversing the treatment, this time replacing the SMF with water, the dBb very slowly decreased in size and finally disappeared. In the meantime, the two oil drops were gradually reappearing, but instead of each spore having, as usual, two oil drops, some spores now had only one (fig. 2). Sometimes the crushed fragments of the ascocarp were so thick that it required two or three days to replace all the SMF with water so that no longer could any dBb be found. Dodge, Singleton and Rolnick (1950) in their Fig. 2 C, show a cluster of asci of the 8-spored *N. tetrasperma* mutant in which two spores in each of two asci contained a very tiny dBb. It is impossible to say now whether those dBb were just appearing or just fading away. Several stages in this oil-drop "bubble" relationship in *Lachnea*

abundans are diagrammed in our Fig. 2 A-J. Those diagrams will be explained later.

Testing for oil in spores and asci. Because of the thick dark-colored spores of *Neurospora*, the oil tests were made mostly with *L. abundans*. Crushed fragments of an ascocarp had recently been immersed in the S III

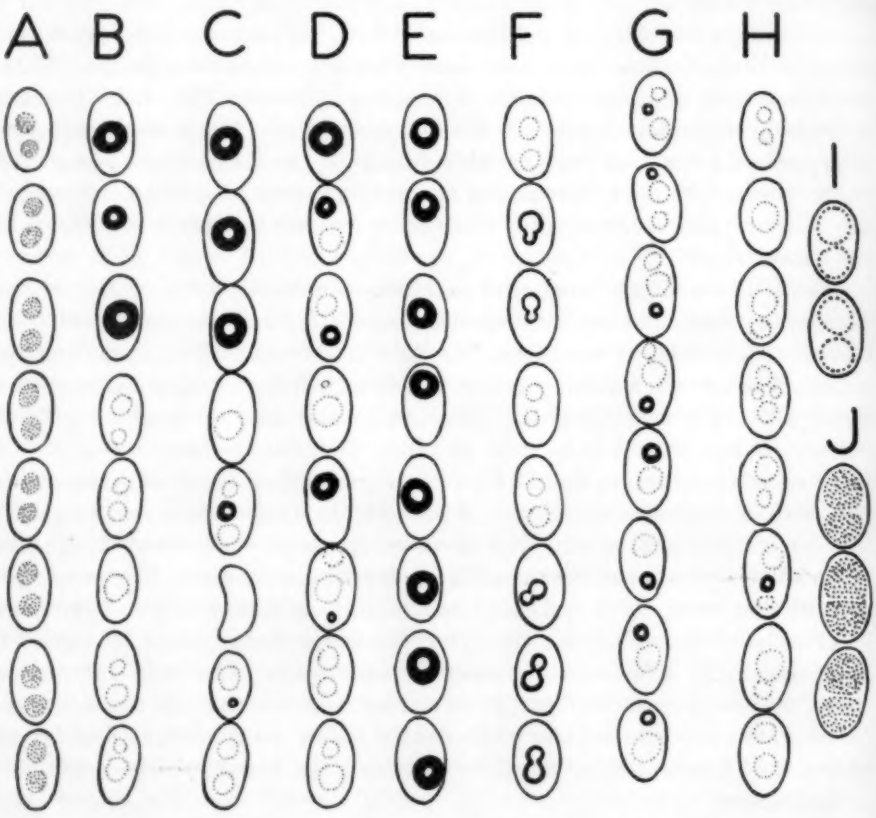


FIG. 2. *Lachnea abundans*. Diagrams of the eight spores in various asci. Asci A, I and J had been immersed in a Sudan III solution. All other asci had been at first immersed in SMF for some hours and then placed in water. A. Each spore had two drops stained reddish, reacting as oil drops. B. Three upper spores had each a single dBb, one of which was now shrinking. C. Again, each of the three upper spores contained one dBb while the 5th and 7th showed that as the dBb shrink, oil drops come into view. One spore had collapsed. D. The dBb in the 6th spore is about to disappear. E. All eight spores, one dBb each just before replacing the SMF with water. F. Interesting because the dBb in five spores seem to have blistered, a rare sight. G. After adding water, the dBb in each spore is on the way of disappearing as oil drops come into view. These dBb had all disappeared completely when examined half an hour later. H. Much like G but the dBb disappeared sooner. I. All eight spores contained two large unstained oil drops. J. Spores from the adjacent ascus I, but here the large oil drops had been stained dark-red.

solution and then left overnight in a damp chamber. It was then found that in 71 asci each spore contained a single dBb as shown in figure 2, E; in 20 other asci each spore had two oil drops which, in the meantime, had been stained some shade of red; in 15 asci each spore had two unstained oil drops; five asci had six spores, each with a single dBb but the other two spores had two colorless oil drops.

In another test, a fragment that had been mounted in water showed that each spore had two normal oil drops. The water was then replaced with the S III solution. In a very short time many spores began to develop the dBb. This also proved that the S III could serve very well as a drying agent for spores while the oil drops in certain other spores in the same mount were stained red.

A squash mount of a similar fragment was first immersed in S III for about an hour. Many spores soon began to develop the dBb. The squash mount was then flooded with water and left in a damp chamber for two days. When examined again, each of the eight spores in 38 asci now contained two unstained oil drops, while each spore in 22 other asci contained two large oil drops that had been stained some shade of orange or red. No spore now contained a dBb. Apparently, those spores that originally developed dBb could most likely have been the ones which, when immersed in water, were the same ones whose oil drops had not originally taken the S III red stain.

In another test, 26 asci showed a single dBb in each of the eight spores, while the oil drops in each of the spores of 20 other asci were found to be stained deep red. In still another mount, the two oil drops in each spore of 80 asci showed simply the large unstained oil drops while in the same squash mount the two oil drops in each spore of 41 asci showed some shade of the red stain. No doubt, if this same cluster of asci had been examined after having been subject to the drying effect of the S III for some hours and then immersed in water, the spores instead of showing *two* unstained oil globules each, would then have been seen to contain clear-cut dBb, *one* in each spore.

Figure 2, B-H, is made up of diagrams of several different asci, each containing eight spores. The mounts had first been immersed in SMF and later flooded with water. The purpose of the diagrams was two-fold. First, to show some of the stages in the shrinking and final disappearance of the dBb and, at the same time, indicate reappearance of oil drops; second, to show that one can find here and there during the tests spores with only a single oil drop. Each diagram was made from a sketch designed to show the presence of dBb and oil drops as they appeared at that particular time. No attempt was made to indicate other spore contents. Only very roughly do the diagrams indicate the true dimensions of dBb, oil drops, spores and asci. Three asci, A, I and J, in this figure had been immersed in S III. The oil

drops shown in the spores of ascus *A* were rather small, but they were stained rose-red, while the red oil drops in ascus *J* were large and were deeply stained red by the S III. The other spores in this ascus are not shown here. The large oil drops in all eight spores of ascus *I* were not stained even though asci *I* and *J* were adjacent in this mount.

It has been shown that if the water in such a squash mount were displaced again by the S III the oil drops in such spores as shown in *I* would have disappeared, and a dBb would have in each case then come to view. We have, however, not yet proved that a dBb would have developed in an ascospore whose red oil drops had been subjected to another immersion in S III. No doubt if alcohol alone had been used as the drying agent, the S III in the oil drops would have been dissolved out so that dBb might then have developed in that spore. To repeat, it still remains to be found that the ascospore that contained oil drops that had absorbed the S III agent, may at the same time show a dBb. It is very easy to demonstrate that definite oil-drops and clear-cut dBb can exist *temporarily* in the same spore. Then why is it that in our *Lachnea*, when we dehydrate the spore, the two oil drops gradually disappear but only one, not two, dBb comes into view? One can't say that two dBb never appear in the same spore. We have actually seen two somewhat abnormal elongated dBb in a few large ascospores of a *N. tetrasperma* hybrid race. Normally, the size of the ascospore does not seem to make any difference. Spores of *N. tetrasperma* are much larger than spores of *N. sitophila*, yet only one dBb develops in each spore.

Oil or other fatty matters in aborted asci. Asci of *N. tetrasperma* that were originally homozygous *Aadd* for the recessive lethal *d* usually abort without spore formation (Dodge 1935). This type of abortion was at first described as deliquescent abortion because the ascus and its contents gradually disappear as the culture ages. Apparently, no one has investigated chemically this type of abortion in *Neurospora*. That such asci contain a great deal of oil or other fatty matters is easily proved by introducing S III under the cover-glass and so displacing the water of the squash mount. Almost at once the entire ascus contents become deeply stained some shade of red, often mixed with gold-yellow. Very often parts of the contents form globules as figured by Dodge. These take the stain very readily and so are apt to be mistaken for spores, "spores without nuclei!" Such deeply stained globules are readily distinguished from ascospores because, rather rarely, an ascus *Aadd* does delimit spores. In such instances, by comparison, no one could fail to distinguish the red-stained spores from the red globules.

The walls of indurated aborted asci of *Neurospora*, due to lethal *I* as well as phenocopies of them, develop dark brown walls with ribs similar in their origin and markings to ascospores themselves. As young asci develop, they become inflated. At this stage, they have thin walls and take the S III stain showing quantities of fatty matter irregularly distributed in globules.

Although many hundreds of the "mature" heavily-walled asci mounted in the SMF have been studied we have never seen a single dBb develop in such asci. By cracking these indurated asci one can prove the presence of some oily matter by using the S III stain.

The conidia of *Lachnea abundans*, when immersed in S III, stain dark red without showing either oil drops or dBb. The conidia do not shrink or collapse. They must be readily permeable to the alcohol carrying the S III. Some conidia of *Neurospora* collapse quickly, yet so far as is noted do not form distinct oil drops or dBb under the same conditions.

The results noted above suggested that squash mounts of normal or wild type perithecia of this species should be investigated by subjecting them to the S III test for fatty matters. When this was done it was discovered that the ascogenous cells, young asci, young spores, and even full-sized spores, take the stain if their walls have not turned olive-green or very dark colored so that the spores were opaque. Spores that were just begining to show the first stages in rib formation often took the red stain. Fully mature spores take no stain. Such spores, however, are the ones that may develop dBb if dehydrated with alcohol, glycerine, or certain other drying agents. This S III solution should prove to be an excellent stain for various stages in the origin and development of the perithecia. Young protoperithecia, as well as outgrowths and other hyphal branches, often take the red stain beautifully, showing the presence of fatty matters.

The following example illustrates the apparent inconsistency with which oil drops and dBb may respond to the S III reagent. Fragments of an ascocarp of *Lachnea abundans* had been mounted in water for some hours. The water was then replaced with the S III solution. Several hours later the S III was in turn replaced with water. When a certain ascus was first examined the top, or first, spore at that time contained two unstained oil drops; the second spore contained a single dBb, no distinct oil drops being present; spore number 3 contained a single large unstained oil drop; the adjacent spore below contained a single large oil drop but this one was stained deep-red; spore number 5 contained two large oil drops, both deeply stained red; spores nos. 6 and 7 each had a somewhat shrunken dBb, but no definite oil drops; spore No. 8 had two normal unstained oil drops. About half an hour later the picture of this ascus was practically the same except that the dBb in spores 2, 6 and 7 had shrunken to become mere vestiges of their original size and appearance. However, where there were at first no oil drops in these three spores, there now showed plainly two unstained oil drops along-side the remains of the dBb. In spores 2 and 6 the vestigeal dBb were now in between, but not touching, the oil drops. See Fig. 2, B–H for diagrams of comparable stages in the appearance and disappearance of oil drops and dBb where the reagent was SMF instead of S III.

Discussion and conclusion. It was pointed out earlier in this paper that

ascospores of *Neurospora* do not show typical oil drops in more or less definite numbers when mounted in water or in SMF. Furthermore, when the young spores are mounted in S III the contents stain beautifully but the fatty mass is not delimited or confined to a definite number of distinct oil drops. The ascospores of *Lachnea abundans* old or young, mounted in water, usually show two clear-cut oil drops. Whether or not every oil drop will be stained red by the S III seems to depend on the age or maturity of the spore at the time. It was interesting to see in the same spore two oil drops and entirely separate and apart from them, a tiny dBb. In such instances, there is a critical period when, not knowing the set-up treatment, one could not tell whether the oil drops were just coming into view or were just beginning to fade out. In either case, the "gas bubble" would be doing just the opposite thing. Since the Sudan III is dissolved in alcohol, it first acts as a drying agent, often resulting in the formation of a single intracellular dBb in certain spores. Furthermore, some spores in the mount will be in that stage of maturity which favors the test for oil. In such spores one sees rose-colored or red oil drops. If the mount is a fresh one there will usually be two oil drops in each spore, occasionally only one. Some asci may be about to delimit the spores. The contents of such an ascus will then become rose-colored due to the S III. Squash mounts of pieces of ascocarps often contain a hundred or more asci. One is then apt to become bewildered seeing so many different types of reactions to the S III. Nevertheless, compared with species of *Neurospora*, this little *Lachnea* (*Patella*) gives us far superior material for the investigation of "bubbles" and oil drops in ascospores.

Those of us who have studied *Gelasinospora tetrasperma* have not reported seeing these curious bodies in ascospores. However, a re-examination of our slide mounts and photographs shows that this species reacts in much the same way as do species of *Neurospora* when their spores are immersed in the SMF reagent. A high percentage of the spores will contain a single dBb. In both cases, under certain conditions or treatments, many spores collapse. This effect was due no doubt, to the fact that such spores had thin walls, or that the drying agent was too strong.

Insert B in our figure 1 shows many spores, each with its single "bubble." The interesting feature here is that the dBb in several spores is off-center, that is, near one end. It was found that when care was taken to leave bits of mycelium or fragments of the perithecium on the slide so that space was left between the slide and the cover glass, the spores at first float around end over end then come to rest. Here and there one finds a spore standing on end as it were. Focusing the microscope, one will always find the dBb. By lightly tapping the cover glass the spore may tip over so that one can see that the dBb is near one end. Usually this spore will rather quickly

become erect again. The question is whether or not it is always the uppermost end of this erect spore that contains the "bubble". Not enough work has been done to warrant any conclusion on this point. De Bary would no doubt have explained this occasional erect position of the ascospores noted above as a state of equilibrium; the "air bubble" being lighter than the other contents of the spore would be in the top end. Ingold could very well say that in this two-phase system the water-vapor "bubble", being lighter, would account for the erect position of the spore.

Reconsider the situation where ascospores of *Lachnea abundans* are mounted in water. The two oil drops in a spore represent rather definite substances. Mounted in the SMF or in Sudan III, for example, the globules gradually lose their definite boundaries, become fainter and finally practically disappear. Meanwhile, beginning as a mere speck, a dBb comes to view and soon attains its full size. Replace the drying agent with water and now it is the dBb that gradually disappears and oil drops come into view. Much is yet to be learned regarding these concomitant activities. The most important questions to be answered seem to be: what is the true nature of these dBb and what, if any, relationship have they to the oil or other fatty matters? De Bary called them air bubbles. Ingold presumed them to be water vapor bubbles. We are leaving it to the microchemist to give us the true answers.

Research Laboratory, The New York Botanical Garden
New York 58, New York

Literature Cited

Bary, A. de 1866. Morphologie und Physiologie der Pilze.

————. 1884. Vergleichende Morphologie und Biologie der Pilze. (Eng. translation, 1887).

Bouier, E. 1905–1910. Icones Mycologici.

Dodge, B. O. 1922. A *Lachnea* with a botryose conidial stage. Bull. Torrey Club **49**: 1–8.

————. 1935. A recessive lethal for ascospore formation in *Neurospora*. Bull. Torrey Club. **62**: 117–128.

————. 1957. Rib formation in ascospores of *Neurospora* and questions of terminology. Bull. Torrey Club **84**: 182–188.

————, **Singleton, J. R. & Rolnick, Anita.** 1950. Studies on lethal *E* gene in *Neurospora tetrasperma*, including chromosome counts in races of *N. sitophila*. Proc. Am. Phil. Soc. **94**: 38–52.

Faull, A. F. 1903. On the resistance of *Neurospora crassa*. Mycologia **22**: 288–303.

Ingold, C. T. 1956. A gas phase in viable fungal spores Nature, **177**: 1242–1243.

Rehm, H. 1896. Discomycetes. Rabenhorst's kryptogamen-Flora. Pilze **3**: 1–1275.

Seaver, F. J. 1928, 1951. North American cup-fungi.

Shear, C. L. and Dodge, B. O. 1927. Life histories and heterothallism of the red bread-mold fungi of the *Monilia sitophila* group. Jour. Agr. Research **34**: 1019–1042.

BULLETIN OF THE TORREY BOTANICAL CLUB
VOL. 84, NO. 6, PP. 442–449 DECEMBER, 1957

PHYSIOLOGY OF GROWTH AND REPRODUCTION IN RICE. I. EFFECT OF PLANT GROWTH SUBSTANCES ON AN EARLY VARIETY

G. MISRA AND G. SAHU

Since the discovery of growth regulators, plant physiologists have engaged themselves in the study of their role in the different processes of plant physiology. Of these, the investigation on the effects of these substances on the various crop plants bringing about a modification in their floral initiation and growth responses has been a fascinating line. Thimann and Lane (1938) obtained better vegetative growth accompanied by slight hastening of flowering with IAA on oat and wheat. Leopold and Thimann (1949) observed in Wintex barley a strong correlation between the number of flower primordia and the weight of the plant, both flowering and growth being promoted by relatively low concentrations and inhibited by higher concentrations of auxins. Gausman and Dungan (1954) observed delay in anthesis and silking in maize by applying various growth substances. Hussey and Gregory (1954) observed increased number of flower primordia in Wintex barley by NAA, but no effect was observed in Petkus rye. Asana, Mani and Vedprakash (1955) observed an increase in growth and grain yield in wheat with two auxins IAA and NAA. Bhardwaj and Rao (1955) observed higher vegetative growth and grain yield with IAA and lower vegetative growth and grain yield with NAA in wheat. Very little work has yet been done on the effect of various plant growth substances on the growth and reproduction of rice. The present investigation aims to study the effects of β-indoleacetic acid (IAA), α-naphthalene acetic acid (NAA) and 2,3,5-triiodobenzoic acid (TIBA), on an early variety (Mitra and Gupta, 1945) of rice.

Materials and methods. Pure grains of an early variety of rice, N. 136, procured from the Central Rice Research Institute, Cuttack, were used in this experiment. After a preliminary selection for uniformity, the grains were soaked in three different concentrations, 500ppm (part per million), 250ppm and 100ppm of each of 3 different plant growth substances, IAA, NAA and TIBA for 72 hours. After a thorough washing in tap water the pre-soaked grains were sown in earthenware pots ($10'' \times 10''$) containing a mixture of soil and cowdung manure in the proportion of 8:1. The grains in the control set were soaked with distilled water containing a small amount of rectified spirit which was used in preparing the hormone solutions in the treated sets. The plants were then separated into two different series, series I was left after the initial soaking without any further treat-

ment, while series II was given in addition a regular foliar spray once a week with the corresponding hormone solution in which the seeds were initially soaked. Each time about 30cc. of hormone solution were sprayed to 24 plants. The spraying was commenced with 3-week-old seedlings and was continued till the panicle emergence in individual plants. Care was taken to maintain uniform soil moisture throughout the experimental period by fre-

TABLE 1. *Time from sowing to ear emergence in the main shoot in days. (Average of 24 plants). Sowing date—Dec. 19, 1955.*

Treatments		Days from sowing to ear emergence			Earliness (+) or delay (−) in days from control
		Seed soaking (series I)	Seed soaking plus spray (series II)	Mean per treatment	
IAA	500 ppm	85.43	84.17	84.80	−0.67
	250 ppm	86.25	85.77	85.95	−1.82
	100 ppm	86.92	85.17	86.04	−1.91
NAA	500 ppm	92.25	92.50	92.38	−8.25
	250 ppm	90.46	87.86	89.16	−5.03
	100 ppm	89.90	87.20	88.55	−4.42
TIBA	500 ppm	86.46	83.50	84.98	−0.85
	250 ppm	85.61	80.10	82.85	+1.28
	100 ppm	84.38	81.29	82.83	+1.30
Controls		85.97	82.29	84.13	——
Mean per series		87.36	84.97		

S. E. Mean for hormone effect = 0.683 and C. D. at 5% = 1.92
S. E. Mean for soaked vrs. soaked plus spray = 0.306 and C. D. at 5% = 0.86
S. E. Mean for interaction = 0.966 and C. D. at 5% = 2.71

TABLE 2. *Analysis of variance.*

Source of variation	D.F.	S.S.	M.S.	F.	5% F.	1% F.
Between treatment:						
Hormone effect	9	993.00	52.26	9.33**	1.97	2.59
Soaked vrs. soaked plus spray	1	171.20	171.20	30.57**	3.94	6.90
Interaction	9	72.84	8.09	1.45	1.97	2.59
Error	100	559.89	5.60			
Total	119	1796.93				

** Significant at 1% level.

quent application of water. As far as practicable all other environmental conditions were kept identical in all treatments. There were six pots under each treatment and each pot after thinning had finally four plants.

Results. Ear emergence. The criterion of ear emergence is taken as the exsertion of the floral axis through the flag leaf sheath of the main shoot. The average days taken from sowing to ear emergence under different treatments are presented in Table 1. The analysis of variance of the data is given in Table 2.

A study of the data in Tables 1 and 2 clearly indicates the significant effects of the growth substances in bringing about a change in the time of ear emergence in both the series, more predominantly in series II, where the plants were subjected to the combined treatment of seed soaking and foliar spray. The slight delay in ear emergence observed in the case of plants treated with IAA solution was found not to be statistically significant. But a conspicuous delay in ear emergence was observed in the plants treated with NAA solution, maximum being in 500ppm concentration. The little earliness observed in plants treated with 250 and 100ppm of TIBA solutions was also found not to be statistically significant.

Vegetative characters. Observations on morphological characters such as number of tillers, total number of green leaves, number of leaves on the main shoot and height of the plants as influenced by the various treatments were made five times during the entire life cycle at fortnightly intervals.

The plants treated with IAA solutions though observed to have less number of tillers in earlier stages, produced more tillers than the controls towards the later stages. Tillering in plants treated with NAA solutions was less than those of the control plants in both series throughout the growing period. On the other hand, the plants treated with TIBA solutions showed more tillers right from the beginning to the end, highest being observed in the plants treated with 250ppm of TIBA.

The formation of leaves was influenced more or less in the same manner as those of the tillers. There was a slight inhibiting effect in the earlier stages followed by an augmentation in the plants treated with IAA. In plants treated with NAA solutions the production of leaves was greatly suppressed in the early stages and to a lesser extent in the later stages. The maximum production of leaves was observed in the plants treated with 250ppm of TIBA solution.

The height of the plants was greatly influenced by the various hormones. At the young stage the plants treated with IAA and NAA although more stunted than those of the control plants, showed a tendency of growing faster towards the later stages so much so that the plants in the IAA set outstripped those of the controls. The plants treated with TIBA solutions were taller than the controls throughout the life cycle of the plants.

Grain yield. After the grains attained full maturity the panicles containing the spikelets were collected separately for each pot. The yield of the grains per plant was recorded after drying the grains in the sun and are presented in Table 3, and their analysis of variance in Table 4.

A significantly higher grain yield was observed in plants treated with IAA solutions, the yield gradually increasing with an increase in the concentration of the IAA solution, the highest being in the plants treated with 500ppm (more than 36%). The plants treated with NAA solutions did not

show any marked increase or decrease in grain yield over those of the controls. The plants treated with TIBA solutions showed a slightly higher grain yield which, however, was not statistically significant.

Components of yield. The data for components of yield such as number of panicles per plant, length of panicle, number of spikelets and grains per

TABLE 3. *Grain yield in gms. (average of 24 plants).*

Treatments		Grain yield per plant in gms.			Percentage of increase (+) or decrease (−) from control
		Series I (seed soaking)	Series II (seed soaking plus foliar spray)	Mean per treatment	
IAA	500 ppm	3.172	3.398	3.285	+36.87
	250 ppm	3.105	3.023	3.064	+27.50
	100 ppm	2.802	2.962	2.882	+20.09
NAA	500 ppm	2.570	2.316	2.443	+ 1.71
	250 ppm	2.419	2.505	2.462	+ 2.58
	100 ppm	2.241	1.975	2.108	−12.16
TIBA	500 ppm	2.792	2.405	2.599	+ 8.29
	250 ppm	2.291	3.057	2.674	+11.42
	100 ppm	3.049	2.885	2.967	+23.62
Controls		2.401	2.398	2.400	———
Mean per series		2.684	2.692		

S. E. Mean for hormone effect = 0.210 and C. D. at 5% = 0.59
S. E. Mean for soaked vrs. soaked plus spray = 0.094 and C. D. at 5% = 0.26
S. E. Mean for interaction = 0.297 and C. D. at 5% = 0.83

TABLE 4. *Analysis of variance.*

Source of variation	D.F.	S.S.	M.S.	F.	5% F.	1% F.
Between treatment:						
Hormone effect	9	13.833	1.537	2.90**	1.97	2.59
Soaked vrs. soaked plus spray	1	0.002	0.002	0.004	3.94	6.90
Interaction	9	2.970	0.330	0.63	1.97	2.59
Error	100	52.995	0.530			
Total	119	69.800				

** Significant at 1% level.

panicle, percentage of grains set per panicle and weight of 1000 grains are given in Table 5.

The number of panicles formed per plant was significantly more in the plants treated with 500ppm of IAA and it was less in the plants treated with 500ppm NAA solution, while in the other concentrations there was no change. The variation in the number of panicles was more conspicuous in series II, where in addition to seed treatment the plants were sprayed with hormone solutions, than those in series I where the treatment consisted of seed soaking only.

Longer panicles were formed in the plants treated with 500ppm of IAA, NAA and TIBA, longest being in plants treated with 500ppm of NAA solution. In all treatments a gradual increase in the length of panicles was observed with an increase in the hormone concentration.

TABLE 5. *Components of yield (average of 24 plants)*

Treatments		seed soaking series I	seed soaking plus foliar spray series II	mean per treatment	seed soaking series I	seed soaking plus foliar spray series II	mean per treatment
		Number of panicles per plant			Length of paniele in cm.		
IAA	500 ppm	4.83	5.42	5.13	19.06	19.27	19.17
	250 ppm	4.67	4.71	4.69	19.13	19.03	19.08
	100 ppm	4.54	5.42	4.98	18.66	18.99	18.83
NAA	500 ppm	4.13	3.50	3.81	19.49	20.68	20.09
	250 ppm	4.04	4.33	4.19	18.80	18.97	18.89
	100 ppm	4.50	4.17	4.33	18.24	18.61	18.42
TIBA	500 ppm	4.50	5.50	5.00	18.95	19.51	19.23
	250 ppm	4.08	5.79	4.93	18.66	19.00	18.83
	100 ppm	4.38	5.54	4.96	18.65	19.07	18.86
Controls		4.04	5.04	4.54	18.48	18.73	18.61
		S. E. Mean for hormone effect = 0.21			S. E. Mean for hormone effect = 0.19		
		Critical difference at 5% = 0.59			Critical difference at 5% = 0.53		
		Number of spikelets per paniele			Number of grains per paniele		
IAA	500 ppm	83.43	83.37	83.40	46.41	44.07	45.21
	250 ppm	86.53	81.54	84.03	46.35	44.59	45.47
	100 ppm	81.38	80.39	80.89	41.75	38.71	40.23
NAA	500 ppm	98.31	102.81	100.56	44.64	47.37	46.01
	250 ppm	87.13	78.83	82.98	42.56	40.56	41.56
	100 ppm	82.71	73.03	77.87	35.59	33.53	34.56
TIBA	500 ppm	85.73	88.19	86.96	45.10	33.44	39.27
	250 ppm	79.59	82.02	80.80	40.00	35.47	37.74
	100 ppm	84.42	84.13	84.27	49.92	36.13	43.03
Controls		82.00	82.13	82.07	43.02	36.67	39.84
		S. E. Mean for hormone effect = 2.48			S. E. Mean for hormone effect = 2.32		
		Critical difference at 5% = 6.96			Critical difference at 5% = 5.51		
		Percentage of grain setting			Weight of 100 grains in gms.		
IAA	500 ppm	55.68	53.27	54.47	14.11	14.25	14.18
	250 ppm	53.69	54.73	54.21	14.50	14.24	14.36
	100 ppm	51.02	48.22	49.62	14.32	14.22	14.27
NAA	500 ppm	45.19	46.25	45.72	14.12	13.94	14.03
	250 ppm	48.94	50.54	49.74	14.11	14.19	14.15
	100 ppm	43.36	46.00	44.68	14.16	13.76	13.96
TIBA	500 ppm	52.19	38.05	45.12	13.64	13.18	13.42
	250 ppm	49.24	42.80	46.02	13.75	13.50	13.63
	100 ppm	58.85	42.72	50.78	13.94	13.94	13.94
Controls		52.35	44.90	48.62	14.20	14.03	14.11
		S. E. Mean for hormone effect = 2.40			S. E. Mean for hormone effect = 0.15		
		Critical difference at 5% = 6.74			Critical difference at 5% = 0.41		

The number of spikelets per panicle was highest in the plants treated with 500ppm of NAA solution. The variation observed in the plants treated with other solutions was not statistically significant.

The number of grains per panicle was more in the plants treated with 500 and 250ppm of IAA and 500ppm of NAA solution.

The percentage of grain setting was not statistically significant in any of the treatments.

Lighter grains were observed from the plants treated with 500 and 250ppm of TIBA solutions. There was no marked change in the individual grain weight in any other treatment.

Discussion. Of the three growth substances used in the present investigation, the auxin NAA alone had produced a significant delay in ear emergence in this variety of rice which is an intermediate one in its photoperiodic behaviour (Misra 1955). The other auxin IAA as well as the so-called auxin antagonist TIBA were without any effects on time of flowering. Thus the present findings are contradictory to those obtained by Tang and Loo (1940), who observed earliness in flowering with a particular variety of rice when soaked with 1 to 100ppm of IAA solution but akin to those of Leopold and Thimann (1949) and Leopold and Guernsey (1953), who obtained inhibition of flowering in Wintex barley and teosinte at stronger concentrations of the auxin NAA as well as at weaker concentrations of the same when followed by warmer temperatures just as were the experimental conditions here.

With regard to the influence on vegetative growth a general tendency was observed in that there had been a suppression of tillering, production of leaves and elongation of the shoot at young stages by the auxins IAA and NAA which, however, was removed to a great extent at the later stages. Thus the results of this investigation corroborate those of Leopold and Thimann (1949), who did not find a promotion of vegetative buds by higher concentrations of auxins in Wintex barley and teosinte. TIBA, however, produced an acceleration effect in all these characters which was apparent at any time throughout the growing period.

Coming now to a discussion of the influence of auxins on reproductive characters, it is seen that IAA at 500 and 250ppm alone produced a significantly higher grain yield clearly due to the cumulative effect of the increase in number of panicles, length of the panicle and number of grains formed per panicle. NAA in 500ppm produced a marked increase in the length of the panicle, number of spikelets and grains per panicle but failed to produce any increase in grain yield because of the fact that the number of panicles formed per plant was low. Thus judged by the criterion of formation of spikelets it may be said that the auxin NAA had brought about an increase in the number of flower primordia, a result similar to those of Leopold and Thimann (1948) and Hussey and Gregory (1954) in Wintex barley. The plants treated with TIBA did not show in general any change in the reproductive characters excepting the fact that significantly

lighter grains were produced indicating that the filling of the grains had been adversely affected by this so-called anti-auxin. The present results with TIBA are thus different from those of Asana, Mani and Vedprakash (1955) where an increased grain yield due to an increase in ear and spikelet number was observed in wheat.

As regards the relative effectiveness of the mode of application of the hormone solution it may be concluded that seed soaking alone is a very effective method by itself but the degree of effectiveness is enhanced to some extent by the additional treatment of foliar application.

SUMMARY

The effect of three plant growth substances, IAA, NAA, and TIBA at 500, 250 and 100ppm upon the growth and reproduction of an early variety of rice has been studied. The treatments consisted of seed soaking only in one series and in the other a combined treatment of seed soaking plus weekly foliar spray. The study has led to the following salient conclusions.

1. IAA had no effect on flowering. It however produced a depressing effect on vegetative characters in the initial stages followed by a subsequent recovery and brought about a higher grain yield consequent upon an increase in number and length of panicles and number of grains formed per panicle.
2. NAA brought about a conspicuous delay in ear emergence and an inhibition of vegetative characters in the early stages but was without any effect on grain yield though the number of spikelets and grains were favourably influenced by 500ppm.
3. TIBA produced no significant effect on flowering but had a marked promoting effect on vegetative characters in all their aspects. It had no effect on grain yield or components of yield excepting bringing about a marked decrease in the grain plumpness at the two concentrations of 500 and 250ppm.

Our thanks are due to the Utkal University, for the award of the Maharajkumari Sudhansumukhi Gajapati Fellowship to one of us (G.S.), to Professor B. Samantarai, for providing facilities for carrying on this investigation, to Sri M. P. Jha for help in statistical analysis and to Prof. K. V. Thimann for helpful criticism.

DEPARTMENT OF BOTANY, RAVENSHAW COLLEGE
CUTTACK 3, INDIA

Literature Cited

Asana, R. D., Mani, V. S. & Vedprakash. 1955. The effect of auxins on the growth and yield of wheat. Physiologia Plantarum, **8**: 279–287.

Bhardwaj, S. N. & Rao, I. M. 1955. Studies on the effect of 2,4-D, NAA, and IAA on growth and maturity of wheat. Jour. Ind. Bot. Soc., **34**: 21–28.

Gausman, H. W. & Dungan, G. H. 1954. Some effects of certain plant growth substances on maize. Bot. Gaz. **116**: 29–40.

Hussey, G. & Gregory, F. G. 1954. The effect of auxin on the flowering behaviour of Wintex barley and Petkus rye. Plant Physiology, **29**: 292–296.

Leopold, A. C. & Guernsey, F. S. 1953. Modification of floral initiation with auxins and temperatures. Am. Jour. Bot., **40**: 603–607.

Leopold, A. C. & Thimann, K. V. 1948. Auxin and flower initiation. Science, **108**: 664.

———. 1949. Effect of auxin on flower initiation. Am. Jour. Bot., **36**: 342–347.

Misra, G. 1955. Photoperiodism in rice II, Photoperiodic response of four early varieties of rice of Uttar Pradesh. New. Phytol., **54**: 29–38.

Mitra, A. K. & Gupta, P. S. 1945. Production of more rice per acre in United Province. Indian Famg., **6**: 398–402.

Tang, P. S. & Loo, S. W. 1940. Tests on after-effects of auxin seed treatment. Am. Jour. Bot., **27**: 385–386.

Thimann, K. V. & Lane, R. H. 1938. After-effects of the treatment of seed with auxin. Am. Jour. Bot., **25**: 535–543.

BULLETIN OF THE TORREY BOTANICAL CLUB
VOL. 84, No. 6, pp. 450–458 DECEMBER, 1957

TORREYA

An annotated Preliminary Catalogue of the Vascular Flora of Rockland County, New York

(Concluded from Bull. Torrey Club 86: 388–392 1957)

J. HARRY LEHR

Additions and Corrections

LYCOPODIACEAE

LYCOPODIUM

*LYCOPODIUM CLAVATUM L. Ground Pine. Clarkestown. (H)

PINACEAE

LARIX

LARIX DECIDUA Mill. European Larch. Further investigation of what appeared to be an isolated adventive led to the discovery that it was a horticultural planting and therefore its inclusion in this list was in error.

GRAMINEAE

TRIODIA

TRIODIA FLAVA (L.) Smyth. All of the material collected in this County by the author is forma CUPREA (Jacq.) Fosberg, rather than the typical species.

MUHLENBERGIA

MUHLENBERGIA FRONDOSA (Poir.) Fern. Wirestem Muhly. Ramapo. (H)

CYPERACEAE

CAREX

CAREX SWANII (Fern.) Mackenz. Swan's Sedge. Haverstraw. (H)

* CAREX TRISPERMA Dew. Three-seeded Sedge. Haverstraw. The author believes this is the southernmost station in the State. Two of its associates are *Clintonia borealis* and *Coptis groenlandica* which the author believes are also at the southernmost limit of their range in New York State. (H)

LILIACEAE

TRILLIUM

* TRILLIUM ERECTUM L. forma CAHNAE (Farw.) Louis-Marie. This form was found growing at two of the stations where the typical species grows. Ramapo. (H)

JUGLANDACEAE

JUGLANS

JUGLANS CINEREA L. Butternut. Haverstraw. (H)

CARYOPHYLLACEAE

ARENARIA

* ARENARIA STRICTA Michx. Rock-Sandwort. Stony Point. A rarity within the Torrey range. The station is just beyond the northern border of the County's only limestone area and this sandwort's associates are a small colony of *Camptosorus rhizophyllus* with many specimens of *Asplenium Trichomanes* scattered in the immediate locale. (H)

Saponaria

Saponaria officinalis L. Bouncing Bet. General. The double-flowered form was found at two stations. (H)

Anemone

Anemone quinquefolia L. Wood-Anemone. General. (H)
A. virginiana L. Thimbleweed. Ramapo. (H)

Coptis

* Coptis groenlandica (Oeder) Fern. Goldthread. Haverstraw. The author believes this station is the southernmost one in New York State. The area in which it is found contains the largest known stand of *Rhododendron maximum* in the County and at its nearest known station (in adjoining Orange County) the plant is also found in association with the same *Rhododendron* species. The plant's other associates at the Rockland County station are described in the annotations appended to *Carex trisperma*. (H)

BERBERIDACEAE

Berberis

Berberis Thunbergii DC. Japanese Barberry. An escape found in all of the townships. (H)

CRUCIFERAE

Sisymbrium

Sisymbrium officinale (L.) Scop. var. leiocarpum DC. Hedge Mustard. Ramapo (H)

LEGUMINOSAE

Lotus

Lotus corniculatis L. Birdsfoot-Trefoil. Ramapo, Clarkestown. (H)

ERICACEAE

Rhododendron

* Rhododendron viscosum (L.) Torr. forma glaucum (Lam.) Voss. Swamp-Honeysuckle. Haverstraw. (H)

LOGANIACEAE

Buddleja

Buddleja Davidi Franch. Butterfly-Bush. This escape is becoming naturalized at both of its stations within this County. (H)

ASCLEPIADACEAE

* Asclepias amplexicaulis Sm. Blunt-leaved Milkweed. Ramapo. (H)
A. verticillata L. Whorled Milkweed. Stony Point. (H)

CONVOLVULACEAE

Convolvulus

Convolvulus sepium L. forma coloratus Lange. Wild Morning Glory. Stony Point. (H)

SCROPHULARIACEAE

Veronica

Veronica peregrina L. Purslane Speedwell. Ramapo, Clarkestown. (H)

COMPOSITAE

Actinomeris

* Actinomeris alternifolia (L.) DC. Wing-Stem. Ramapo. A single station for this rarity, on the border of a wooded swamp. (H)

ANTHEMIS

* ANTHEMIS ARVENSE L. Corn-Chamomile. Ramapo. (H)

MATRICARIA

* MATRICARIA MATRICARIOIDES (Less.) Porter. Pineapple-Weed. Ramapo. (H)

FIELD TRIP REPORTS

June 8–9, White Memorial Foundation Property, Litchfield, Conn. A variety of habitats were visited including managed areas and natural areas. On the managed areas attention was drawn to the possibilities of using selective spraying on utility right-of-ways and developing blight-resistant chestnut trees by means of hybridizing, grafting and inarching. In the natural areas attention was drawn to such phenomena as the plant zonation around an undisturbed pond (*Decodon verticillatus, Myrica, Clethra alnifolia* etc.) and tree reproduction in an uncut mature woodland (hemlock in the shade and yellow birch in large openings resulting from the fall of two or more large trees). Among the more interesting plants seen were *Marsilea quadrifolia. Selaginella apoda, Ranunculus subrigidus* (Drew), *Calla palustris, Cypripedium acaule* (with a white pouch), and *Lycopodium tristachyum.* On the second day of the trip visits were made to a station of *Cypripedium calceolus* var. *pubescens* in Goshen, Conn. and to the Bartholomew's Cobble which is a limestone outcropping overlooking the Housatonic River in Ashley Falls, Mass. A number of limestone-loving ferns were seen at the Cobble including Wall Rue, Walking Fern, Purple Cliff Brake, and Scott's Spleenwort. Attendance 15. Leader, Gordon Loery.

June 16. Iona Island, N. Y. One of the botanical features of this area is a single specimen of *Ptelea trifoliata* (common hop-tree), the only one known in Rockland County. This field trip disclosed the tree all but dead as the result of right-of-way spraying by the railroad where this plant grew beside the tracks. Yet, this loss was somewhat compensated by the discovery of a station on the island for *Arenaria stricta* (rock sandwort), a rarity within the Torrey range and a new addition to the flora of Rockland County. Attendance, Torrey 5; Connecticut Botanical Society 1. Leader, J. Harry Lehr.

July 21, 1957. Many Swamps Trail, Harriman-Bear Mountain Section, Palisades Interstate Park, New York. The leader would like to believe that a temperature close to one hundred degrees, rather than a lack of interest, was responsible for the appearance of only three persons at this meeting. An abnormally dry season, with rainfall seven inches below normal at this date, gave the small group an opportunity to explore Great Green Swamp in its entirety. This is the largest of the mountain swamps in Rockland County and it contains many plants of a typical bog association. Earlier, a brief foray was made into Squirrel Swamp where fresh *Dulichium* rhizomes and flowers were collected for Prof. Dr. Th. Eckhardt, Institut fur Systematische Botanik und Pflanzengeographie der Freien Universitat Berlin, who is studying this plant. *Dulichium* is the dominant sedge in Squirrel Swamp. Three additions were made on this trip to the Rockland County list which the leader is compiling. They were *Festuca obtusa, Juglans cinerea,* and *Rhododendron viscosum* forma *glaucum.* Attendance 3. Leader, J. Harry Lehr.

BOOK REVIEWS

Marine Algae of the Northeastern Coast of North America. 2nd ed. By W. R. Taylor. The University of Michigan Press, Ann Arbor. viii + [2] + 509 pp. including 60 pls. 1957 [May 25]. $12.50.

In 1937 Professor Taylor fulfilled a long-existing need by providing us with a manual of the green, brown, and red algae of the northeastern coast of North America. The demand for this work has necessitated the issuance of a new edition and the author has used this opportunity to bring knowledge of the flora up-to-date.

The plan followed in the second edition is the same as in the first edition. The volume starts with a discussion of the geographical distribution of the algae of the area covered, which is from Virginia northward to the eastern American arctic, including Hudson Bay. It is pointed out, however (p. 24), that "The practical southern limit to the reliability of the present manual is New Jersey, . . ." Actually, the flora of this long coastline is remarkably uniform and with only a few exceptions the species occurring along the New England coast are representative of the entire region. The introduction includes remarks on ecology, suggestions on methods of collecting and preserving algae, and concludes with an historical review of algal work in the area and a statement of the purposes and limitations of the volume.

A systematic list is given next which is useful in that it shows at a glance the orders, families, genera and species represented in the flora. In the first edition 393 species were recognized whereas 401 species are treated in the present edition. *Chlorochytrium gloeophilum*, which was accepted in the first edition, is not accounted for in the new edition.

The bulk of the work consists of the descriptive catalogue. First (pp. 33–35), keys are furnished for the four classes, and the orders comprising them. Since the classes in question are usually readily recognized, most users of the book probably will turn directly to the place where the class in hand is treated and it therefore would have been more convenient if the keys to the orders had been given there rather than at the beginning of the catalogue, where they will be easily overlooked.

The author and date of publication of each genus is given, but only the author's name for the species. The bibliography includes only a few of the references to the original descriptions of the genera and species. The failure to give this essential information constitutes a real shortcoming in the work in the opinion of the reviewer. The author remarks (p. 24): "For the better-known species original citations seem superfluous, for the interested student will be able to reach them, . . ., through De Toni's *Sylloge Algarum*." It is time-consuming to have to turn to De Toni each time one wishes to know when and where a species was first described. The greatest disadvantage, however, is to those many people who do not have ready access to De Toni. They may have to search through many books before they will find the reference. Professor Taylor has furnished references to work done on American material of the species (as he remarks on p. 24) but inasmuch as the great majority of the species of the area are based on European material, the importance of the European literature (original description and at least one modern account) probably exceeds that based on American material, which in some instances may not be entirely representative of the species.

The wrong date of publication (and in a few instances the wrong author) is given for a number of genera. In the following list the correct year is given in parentheses: *Vaucheria* De Candolle 1805 (1801), *Giffordia* (Batters) Hamel 1939 (Batters 1893), *Mikrosyphar* Kuckuck 1894 (1895), *Myrionema* Grèville 1872 (1827), *Ascocyclus* Magnus 1872 (1874), *Elachistea* Duby 1832 (1830), *Arthrocladia* Duby 1832 (1830), *Striaria* Greville 1830 (1828), *Chorda* Stackhouse 1816 (1797), *Sargassum* C. Agardh 1821 (1820), *Nemalion* Targioni-Tozzetti 1818 (Duby 1830), *Polyides* C. Agardh 1823 (1822), *Petrocelis* J. Agardh 1862 (1852), *Platoma* (Schousboe) Schmitz 1889 (Schmitz 1897), *Turnerella* Schmitz 1899 (1896), *Agardhiella* Schmitz 1889 (1896), *Hypnea* Kützing 1813 (Lamouroux 1813), *Trailliella* Batters 1876 (1896), *Seirospora* Harvey 1849 (1846), *Spermothamnion* Areschoug 1877 (1847), *Plumaria* Stackhouse 1809 (Schmitz 1896), *Rhodomela* C. Agardh 1823 (1822).

Students of the geographic distribution of algae in the North Atlantic and monographers will be sorry to see that a number of species previously reported from the area covered by the volume (in several instances species based on material from the area) are still treated by way of footnotes as they were in the 1937 edition. In view of Professor Taylor's intimate knowledge of the algae of the region, no person is better qualified than he to settle the status of these questionable records. In a few instances the voucher material may have been lost or be inadequate for precise determination but in most cases examination of the specimens probably will quickly reveal their identity.

The classification and nomenclature in general are up-to-date. In a number of instances the author has not used the classification and nomenclature adopted by other

recent authors. The following are some examples of this. *Giraudya*, *Arthrocladia*, and *Myriotrichia* are placed in the Elachisteaceae (Chordariales), Desmarestiaceae, and Punctariaceae instead of in the Giraudyaceae (Punctariales), Arthrocladiaceae, and Myriotrichiaceae, respectively. Only one family is recognized in the Laminariales whereas *Chorda* and *Alaria* are usually referred to the families Chordaceae and Alariaceae, respectively. If *Conchocelis* is recognized as an autonomous genus, it should be placed in the Bangioideae instead of the Florideae. *Ceratocolax* is placed in the Choreocolaceae (Cryptonemiales) instead of the Phyllophoraceae (Gigartinales).

As was true of the first edition of this work, the present edition will serve as a reference work throughout the world. Outstanding features of the book are the full descriptions of the various taxa and the excellent illustrations of a large number of the species. The demand for the volume, despite the high price, should be even greater than it was for its predecessor.—GEORGE F. PAPENFUSS, Department of Botany, University of California, Berkeley.

Plant Classification. By Lyman Benson, Professor and Head, Department of Botany, Pomona College. xiv + 688 pp., frontispiece (an interesting photograph of Asa Gray with his plant press at La Veta Pass, Colorado) and 492 line drawings and photographic figures. D. C. Heath & Co., Boston, Mass. 1957. Price $9.00.

In this book, the author has brought together a vast amount of information dealing with the problems of plant classification. He has produced a logical and teachable presentation of the subject which the student should comprehend with little difficulty. All plant families of the flowering plants, gymnosperms and pteridophytes represented in North America north of Mexico by native or introduced species growing without intentional aid of man, including nearly all the families of flowering plants in cultivation, are included.

As is stated in the preface, Plant Classification is an elementary text designed for a college course without prerequisite, with the earlier chapters elementary and the latter ones progressively more and more advanced. The objectives which are representative of such an elementary text, which necessarily deals only with families or taxa of higher status, as stated by the author are: (1) acquiring an adequate descriptive vocabulary; (2) application of keys in the process of identification; (3) gaining knowledge of plant taxa through the formation of an ordered collection; (4) gaining knowledge of a basis for classification of plant groups; (5) gaining an appreciation of the association of species in natural vegetation. It is believed that this book adequately fulfills these objectives.

The book includes a total of 25 chapters plus an appendix. The first eight chapters cover a technical but essential descriptive vocabulary and clear illustrations covering fully the morphological characteristics of flowering plants. These are followed by chapters dealing in considerable detail with the process of identification including manuals of the orders and families of monocotyledons and dicotyledons. The keys and descriptions offer the following features: (1) a simplified vocabulary; (2) arrangement according to a new system of classification; (3) natural keys leading to the orders and their included families.

A unique feature in the manual part covering the dicots is a preliminary list of certain plants exhibiting unusual character combinations for each of the author's five groups of orders. These lists are designed as an aid to the student in properly keying certain plants which may lack adequate or pertinent key characters or exhibit exceptional or obscure characteristics.

Each order is described and its relationship and position in the Engler and Prantl and the Bessey systems discussed. Most of the orders are extensively illustrated and provided with a key to the member families. Each family in turn is described and its distribution, economic importance and certain distinctive or representative genera discussed. Three orders, the Caricales, type family Caricaceae; Empetrales, type family Empetraceae; and Elaeagnales, type family Elaeagnaceae, are described as new.

One chapter is devoted to the various techniques employed in the collection, preparation and preservation of plant specimens. This is followed by five chapters which consider the basis for classification. Here, the author presents the significant part evolution plays on classification, some fundamental problems of plant classification, the historical development of classification systems, a comparison and evaluation of recent systems of classification and a system of classification designed for teaching wherein the author presents an innovation in the form of a new concept of the classification of the flowering plants.

In this new system, based on the most up-to-date evidence available, the dicotyledonous orders are arranged in five groups: (1) Thalamiflorae (with hypogynous, choripetalous or apetalous flowers); (2) Corolliflorae (with hypogynous, sympetalous flowers); (3) Calyciflorae (with perigynous or epigynous, choripetalous or apetalous flowers); (4) Ovariflorae (with epigynous, sympetalous flowers); (5) Amentiferae (trees and shrubs with catkins.) These are treated only as groups of convenience and are not to be considered as having formal nomenclatorial status. The name Ovarflorae is used here for the first time, the others having been previously employed by DeCandolle and by Bentham and Hooker.

The new system is based on evidence from many sources but primarily on the Engler and Prantl and the Bessey systems with certain modifications. For the sake of convenience as well as lack of sufficient evidence to properly place them in the scheme of orders, the Amentiferae is maintained as a possibly artificial group with the orders therein contained considered more advanced than primitive, contrary to the Engler and Prantl concept, and not necessarily even closely related between themselves. The author retains the division of the dicots into choripetalous (or apetalous) vs. sympetalous but deëmphasizes this character which he considers almost wholly artificial. The Ranales and Alismales are, as in the case of the Bessey system, taken to represent the most primitive of the orders from which he recognizes gradual departures by others in floral characters correlated with specialization resulting in insect or other advanced means of pollination. The division of the dicots into hypogynous vs. perigynous or epigynous is retained but not emphasized.

His chart of the dicots is designed as a square divided into four equal parts corresponding to the first four groups. The Amentiferae is attached as a lateral appendage. In each of the squares are arranged the constitutent but unconnected orders in a manner reminiscent of the familiar Bessey chart. The position in the chart of any order is expressed in rough proportion by the chart distance of each order from the Ranales and Alismales. He likens his chart of unconnected orders to a group of coral islands which appear distinct to the eye but which may be connected beneath the surface. Those parts of the islands above water are comparable to the living orders. In the case of the monocots, he places less emphasis on superior and inferior orveries and, in comparison with Bessey, presents a realignment of several orders.

The gymnosperms are divided into four classes: (1) Conopsida (a new name = Coniferae of Endlicher); (2) Ephedropsida (a new class); (3) Gnetopsida (a new class); (4) Cycadopsida (a new name = Zamiae of Endlicher). A vocabulary describing gymnosperm characteristics, a manual of the major taxa including keys to orders and families, a discussion of the basis for classification, and a chart showing relationships of classes and orders are given as in the case of the flowering plants.

The pteridophytes are divided into four divisions: (1) Pteridophyta (ferns); (2) Sphenophyta (a new name and status = class Equiseta of Endlicher); (3) Lycophyta (a new name and status = class Selagines of Endlicher); (4) Psilophyta (a new division —Psilotum). As in the case of the previous groups, a descriptive vocabulary, a manual of the major taxa, the basis for classification, together with a chart showing the relationships of the divisions, classes and orders are given.

The final two chapters present a classification of natural vegetation from the ecological viewpoint and the floras of North America in which characteristic woody species are listed and classified under the author's proposed new grouping. The appendix includes a unique discussion of favorable seasons for plant collecting in various parts of North America.

The book is attractively printed in an easily read type with the pages in a two-

column format with the exception of the glossary, which covers more than 1000 botanical taxonomic terms applied to vascular plants, and the index both of which are of three columns. The illustrations are scattered adjacent to the pertinent parts of the text and are numbered serially for each chapter rather than consecutively for the book as a whole. The advantages or reasons for this method are not obvious. The illustrations are line drawings or photographs and are well selected to illustrate the various characters of the plant or vegetation. The drawings are well done and sufficiently large to show clearly all details. A large number of the plant dissections as well as other illustrations were done by Jerome D. Loudermilk. The remainder, a considerable number, with the exception of a few by Lucretia B. Hamilton, are by the author.

While this book has been avowedly designed as a text for beginning students of plant classification, it contains a wealth of information and much food for thought which will be found of interest to those more advanced in the subject.

It is a must for every student of plant taxonomy and should also prove very useful to botanists of other disciplines.—T. G. YUNCKER, DePauw University.

The Ecology of the Watchung Reservation, Union County, New Jersey. A Description of the Biotic Communities and Recommendations for their Management. By James Baird. 83 pages, 10 figures including 5 maps and several photographs (Photo offset process). The Department of Botany, Rutgers—The State University of New Jersey, New Brunswick, New Jersey. 1956. $1.50.

The management of biotic communities in reservations has been an almost entirely neglected field. However, with increasing population pressure upon these wild areas progressive administrative officials are becoming more and more aware of the need for this type of thinking within their long-range planning. In this respect the present contribution is a pioneer venture in studying the dynamics of such communities and outlining specific recommendations for their manipulation with the objective of maintaining as many different habitats as possible.

The area studied, the Watchung Reservation, Union County, New Jersey, consists of 2,000 acres dominated by fields and forest in close proximity to several industrial cities. The primary objective of setting the area aside is stated as follows: "It is the intention of the Commission to preserve this entire tract in its largely primeval state, avoiding the polish and finish of a city park, but to make it more accessible and reasonably available to picnickers, campers, fishermen and all lovers of nature, by providing roads, trails and bridle paths." Therefore, taking into account the above, the general aims of the study include a description of the existing biotic communities, an interpretation of the natural changes taking place and recommendations concerning management problems. The latter includes manipulation and control of the habitats and general problems of land use which obviously affect them.

The general plan of presentation includes vegetational history, geography, general structure and composition of the plant communities, trends of vegetational change and manipulation of the communities, a section on the animal population and concludes with land use management.

Within the reservation numerous communities are recognized and described—an oak forest forms the matrix into which the others such as the hemlock-northern hardwoods, marshlands and old fields are interspersed. Former open agricultural land is rapidly becoming dominated by shrubby species and/or early forest growth. In addition to the text material in this section, pertinent supporting data would aid the reader greatly in interpreting community dynamics. A few figures on size and ages of trees in the various stands would also have given a more complete picture of the existing associations.

In outlining land use recommendations the initial objective is to preserve the natural aspects in every way possible. In the forests the natural successional trends will continue with little or no manipulation by man. This apparently will lead to an increase in the more shade tolerant northern hardwoods. Probably only on the ridges will the more xeric oak type persist. It is to the former agricultural land that most of the

recommendations are directed. Here for example periodic plowing is recommended to maintain an annual stage. To keep the perennial stage, selective elimination by herbicides (2,4-D; 2,4,5,-T) of woody species is prescribed while for later woody stages in the succession, similar selective techniques are recommended to maintain various combinations of species.

The author might also have justifiably added the possibility of preserving certain forest stands by selectively eliminating invading species. This of course would be done only after careful analysis but it might permit the display of those forest trees which would tend to disappear in the normal successional processes. Another habitat often aesthetically desirable is grassland with only the most ornamentally attractive perennials such as butterfly weed, black-eyed Susans, etc. Other less attractive broad-leafed forms which might dominate in the perennial stage could be eliminated by treatment with 2,4-D.

One of the more significant aspects of this report is an actual schedule of treatments for the various areas which extends over a twenty year period. In following these recommendations two important procedures become evident. One involves *conversion*, i.e. that of initial manipulation to obtain the habitat desired and secondly, that of *maintenance*, i.e. those treatments following conversion in order to eliminate reinvading species.

In discussing foreign plants the introduction of such is discouraged. This is surely a sound policy when one analyzes the many serious problems introduced species have already created in our native vegetation. It really seems unnecessary when one evaluates the many fine native ornamentals readily available.

The section on animal populations include the avifauna, amphibians, reptiles and mammals. The treatment of the bird population is extremely thorough and greatly exceeds that given the other forms. Birds typical of the various habitats are enumerated with pertinent notes. A breeding bird census gives more specific data on the dominants extrapolating on the number of pairs per 100 acres. In addition, an extensive annotated checklist of the birds seen within the reservation is included. A checklist of reptiles, amphibians and mammals follows with accompanying notes. The importance of habitat manipulation is strikingly evident in the fact that the cricket frog is no longer found within the reservation.

This work should be enthusiastically received by those administering similar areas. The application of these techniques will also be invaluable to home owners who are interested in natural landscaping for aesthetic and/or wildlife values.—WILLIAM A. NIERING, Department of Botany, Connecticut College, New London, Connecticut.

Diseases of Field Crops. By J. G. Dickson. Ed. 2. 517 pages. McGraw-Hill Book Company, New York. 1957. $8.50.

This newly revised edition again is divided into 4 main sections with 2 appendices. Following the general introductory section, which contans a discussion on physiological anatomy of plant groups in relation to disease, are the sections dealing with the important diseases of cereals, grasses, legumes and fiber crops. The appendices contain (1) a suggested course outline for the diseases of field crops, and, (2) a host index common to the organisms listed in the text.

This edition has been enlarged to include several new diseases, new illustrations and more recent research on field crops. More than 400 diseases, incited by viruses, bacteria and fungi are listed and discussed. Diseases are arranged under the various crops according to the primary causal factor. These include physiogenic, virus, bacterial and fungus diseases. The ever increasing role of nematodes as pathogens and contributors in fungal diseases is also discussed.

Each disease is discussed with the emphasis on (1) characteristics useful in diagnosis, (2) a description of the pathogen, and, (3) control measures—which include practical problems of crop rotation, adaptation and the use of disease resistant varieties.

Newly included in this edition are diseases of peanuts and such annual and perennial legume plants as *Crotalaria, Lespedeza, Lotus, Vicia* and *Vigna* which are coming into

general use in certain areas in soil improvement programs.—RAYMOND CAPPELLINI, Department of Plant Pathology, Rutgers, The State University of New Jersey, New Brunswick, N. J.

Drawings of British Plants. Part X. By Stella Ross-Craig. 33 plates, index. G. Bell & Sons, Ltd. London, 17 Ap. 1957. 8s. 6d.

The parts of this work continue to appear with commendable regularity (cf. Bull. Torrey Club **83**: 442). The current installment illustrates Saxifragaceae and Crassulaceae: 15 species of *Saxifraga*, 2 of *Chrysosplenium*, 1 *Parnassia*, 5 of *Ribes*, a *Tillaea*, an *Umbilicus*, and 8 species of *Sedum*. Saxifrages are common in the British Isles not only on rocks and mountains but on old walls also. Seven of the species here illustrated are circumboreal and enter the United States. Four of the sedums also grow in North America, and *Parnassia palustris*. These fine diagnostic drawings will therefore be of use to American botanists. The price works out at $1.19.—H. W. RICKETT.

Reading the Landscape. By May T. Watts. MacMillan Company. 1957. $4.75.

The landscape which Mrs. Watts reads lies chiefly in the midwest where most of her experience lies. (A chapter on the Great Smokies and two on the Rockies are included.) One does not, however, need personal experience of the areas covered to enjoy and profit from her reading lesson.

READING THE LANDSCAPE is basically sound ecology, well-written, presented mainly from the historical and successional angle. It is no mere collection of descriptive essays of the beauties of nature, but is full of the exciting findings of the students of vegetation and flora. The author has used the not uncommon device of threading each chapter on a central theme, sometimes contrived, but she has avoided with uncommon success blatant contrivance.

Some of the best chapters are those on her home territory—the prairies of Illinois and the sand dunes and quaking bogs of northern Indiana. Here is country which she knew as a child and learned to interpret while a student under Dr. H. C. Cowles, and she is a naturalist at the Morton Arboretum near Chicago. Also very good is her detective work in reconstructing history in a country school yard—her clues ranging from coal dust to Palmer script to tree rings.

Mrs. Watts' sketches highlight the book—pictured diagrams which greatly illuminate and clarify the text and which are more meaningful than photographs and conventional graphs and diagrams often are. And they have the added attraction of a rare and delightful touch of humor.

Mrs. Watts has provided an index which is unusually thorough in a book intended for the lay reader, and each chapter has a list of references which is good and provocative—provocative in that it is stimulating to further reading, and also provocative in the sense of exasperating. The lists have absolutely no discernible organization; many of the references are cited in the text, but there is no consistency on this; and in some cases this reviewer suspects that Mrs. Watts included references which she supposed, from their titles, to be applicable, but which she had not read or had misinterpreted.

I have spoken of the book as being addressed to the lay reader, and Mrs. Watts herself says it is for the general reader. She seems, however, to have wavered in her focus on her audience—at times avoiding technical terminology, and at other times using it to an extent which might be discouraging to anyone needing untechnical language. Particularly jarring is reference in one sentence to the *skin* of a leaf and also to its *palisade cells* and *stomata openings* (p. 137).

Nevertheless, READING THE LANDSCAPE is heartily recommended to field botanists. Teachers should find it valuable for college students, as well as for high school youngsters. And I suggest that you put it on your Christmas list for that young adult you are hoping will share your own pleasure in reading the landscape.—HELEN F. BUELL.

BULLETIN OF THE TORREY BOTANICAL CLUB
VOL. 84, NO. 6, PP. 459–471 DECEMBER, 1957

INDEX TO AMERICAN BOTANICAL LITERATURE

COMPILED BY

LAZELLA SCHWARTEN

WITH THE COLLABORATION OF THE EDITOR OF BRITTONIA

TAXONOMY, PHYLOGENY AND FLORISTICS

ALGAE

(See also under Ecology and Plant Geography: **Shields et al.**)

Flint, Lewis H. Notes on algae of Quebec I.—Mont Tremblant Provincial Park. Nat. Canad. **84**: 157–160. Jl 1957.

Silva, Paul C. Remarks on algal nomenclature. Taxon **6**: 141–145. 21 Je 1957.

BRYOPHYTES

Andrews, A. LeRoy. Taxonomic notes. XIII. The genus *Campylium*. Bryologist **60**: 127–135. Je [Jl] 1957.

Bartram, Edwin B. Mosses from the United States Antarctic Service Expedition, 1940–41 [*Tortula conferta*, sp. nov.]. Bryologist **60**: 139–145. Je [Jl] 1957.

Bartram, Edwin B. Mosses of Upolu, western Samoa. Occ. Pap. Bishop Mus. **22**: 15–30. 22 Jl 1957.

Bryan, Virginia S. Cytotaxonomic studies in the Ephemeraceae and Funariaceae. Bryologist **60**: 103–126. Je [Jl] 1957.

Bryan, Virginia S. & Anderson, Lewis E. The Ephemeraceae in North America. Bryologist **60**: 67–102. Je [Jl] 1957.

Clark, Lois. *Frullania haematocysta*. Bryologist **60**: 151–154. Je [Jl] 1957.

Hassel de Menendez, Gabriela G. *Monoclea Forsteri* en Argentina. Bol. Soc. Argent. Bot. **6**: 248–250. Ap 1957.

Herzog, Th. Eine Briophytensammlung aus dem argentinischen Nationalpark Nahuelhuapi. Darwiniana **11**: 207–222. 31 My 1957.

Holman, Kjeld. The sporophyte of *Mnium hymenophyllum* [*Cyrtomnium*, gen. nov.]. Bryologist **60**: 134–138. Je [Jl] 1957.

Koch, Leo Francis. Louisiana muscology 2. The herbarium of Tulane University, New Orleans. Brittonia **9**: 69–71. 30 Jl 1957.

Schuster, Rudolf M. Boreal Hepaticae, a manual of the liverworts of Minnesota and adjacent regions. II. Ecology. Am. Midl. Nat. **57**: 203–256. Ja 1957. 257–299. Ap [Jl] 1957.

Schuster, Rudolf M. Notes on Nearctic Hepaticae. XII. *Marsupella paroica* n. sp. Bryologist **60**: 145–151. Je [Jl] 1957.

FUNGI

Allard, H. A. Occurrence of the lichen *Cetraria islandica* Ach. in Virginia and West Virginia. Castanea **22**: 106–109. Je [Au] 1957.

Chowdhury, S. Notes on fungi from Assam, II. Lloydia **20**: 133–138. Je [S] 1957.

Corner, E. J. H. Some clavarias from Argentina. Darwiniana **11**: 193–206. 31 My 1957.

Dix, W. L. Jamaica lichens. Some unreported collections. Bryologist **60**: 154–165. Je [Jl] 1957.

Frezzi, Mariano J. Especies de *Pythium* fitopatógenas identificadas en la República Argentina. Revista Invest. Agr. [Buenos Aires] **10**: 113–241. Au 1956.

Hesler, L. R. Notes on southeastern Agaricales, I. Jour. Tenn. Acad. **32**: 198–207. Jl 1957.

Imshaug, Henry A. The lichen genus *Pyxine* in North and Middle America. Trans. Am. Micr. Soc. **76**: 246–269. Jl 1957.

Olive, Lindsay S. Two new genera of the Ceratobasidiaceae [*Metabourdotia, Heteromyces*] and their phylogenetic significance. Am. Jour. Bot. **44**: 429–435. My [22 Jl] 1957.

Reid, Derek A. The taxonomy of *Stereum traplianum* Velenovsky. Brit. Mycol. Soc. Trans. **40**: 200–202. Je 1957.

Von Arx, J. A. Three new fungi from North America. Acta Bot. Neerl. **6**: 381–385. Au 1957.

Wells, Kenneth. Studies of some Tremellaceae. Lloydia **20**: 43–65. Mr [Ap] 1957.

SPERMATOPHYTES

Adams, William P. Notes on the genus *Lysimachia* in Georgia. Bull. Ga. Acad. **14**: 95–101. 1956.

Bacigalupo, Nélida Maria. Rubiáceas argentinas de las tribus Guettardeae y Chiococceae. Darwiniana **11**: 140–162. 31 My 1957.

Barneby, R. C. A new species of *Laphamia* [*staurophylla*] from New Mexico. Leafl. West. Bot. **8**: 168–170. 16 Au 1957.

Barrett, Wilfredo H. G. Anomalía floral en *Pinus*. Revista Invest. Agr. [Buenos Aires] **10**: 43–47. Ap 1956.

Barros, Manuel. Notas sobre *Carex*. Bol. Soc. Argent. Bot. **6**: 207–211. Ap 1957.

Barros, Manuel. Un *Juncus* nuevo del Brasil meridional. Darwiniana **11**: 283–285. 31 My 1957.

Barroso, G. M. Scrophulariaceae indígenas e exóticas no Brasil. Rodriguésia **15**[27]: 9–108. D 1952.

Beaudry, Jean R. & Chabot, Denise L. Studies in *Solidago* L.—I. *S. altissima* L. and *S. canadensis* L. Contr. Inst. Bot. Univ. Montréal **70**: 65–72. Je 1957.

Bernard, Jean-Paul. Notes sur la distribution du faux-gui [*Arceuthobium pusillum*]. Nat. Canad. **84**: 153–155. Jl 1957.

Biloni, José Santos. Observaciones sobre las flores cleistógamas de la malvácea *Pavonia sepium* Saint Hilaire. Darwiniana **11**: 286–289. 31 My 1957.

Bragdø, Marie. Interspecific crosses in *Lupinus*. Hereditas **43**: 338–356. 10 Jl 1957.

Bravo H., Helia. El género *Neodawsonia*. An. Inst. Bot. [Mexico] **27**: 7–17. 1956.

Buchinger, Maria & Falcone, Rodolfo. *Cedrela mexicana* M. J. Roemer, especie nueva para la flora argentina. Darwiniana **11**: 290–292. 31 My 1957.

Burkart, Arturo. Las dipsacáceas asilvestradas en la Argentina. Bol. Soc. Argent. Bot. **6**: 243–247. Ap 1957.

Burkart, Arturo. Leguminosas nuevas o críticas, V. Darwiniana **11**: 256–271. 31 My 1957.

Burkart, Arturo. Tres leguminosas nuevas del oeste argentino. Bol. Soc. Argent. Bot. **6**: 223–232. Ap 1957.

Cabrera, Angel Lulio. El género *Carelia* (Compositae). Bol. Soc. Argent. Bot. **6**: 239–242. Ap 1957.

Carlquist, Sherwin. The genus *Fitchia* (Compositae). Univ. Calif. Publ. Bot. **29**: 1–143. *pl. 1–35.* 16 Jl 1957.

Celarier, Robert P. *Elyonurus argenteus*, a South African grass with five chromosome pairs. Bull. Torrey Club **84**: 157–162. My–Je [25 Jl] 1957.

Cody, W. J. New plant records for northern Alberta and southern Mackenzie District. Canad. Field-Nat. **70**: 101–130. Jl–S 1956 [My 1957].

Core, Earl L. The genus *Scleria* in Brazil. Rodriguésia **15**[27]: 137–162. D 1952.

Crampton, Beecher. Notes on Californian grasses. Madroño **14**: 109, 110. 30 Jl 1957.

Critchfield, William B. Geographic variation in *Pinus contorta.* Maria Moors Cabot Found. Publ. **3**: i–vii, 1–118. 1957.

Cuatrecasas, José. The Colombian species of *Tetrorchidium.* Brittonia **9**: 76–82. 30 Jl 1957.

Cuatrecasas, José. A new genus and other novelties in Compositae. Brittonia **8**: 151–163. 8 Ap 1955.

Dore, William G. *Wolffia* in Canada. Canad. Field-Nat. **71**: 10–16. Ja–Mr [Jl] 1957.

Dressler, Robert L. The genus *Pedilanthus* (Euphorbiaceae). Contr. Gray Herb. **182**: 1–188. 26 Jl 1957.

Duncan, Wilbur H. *Asimina* (Annonaceae) in Georgia. Bull. Ga. Acad. **15**: 9–15. 1957.

Dwyer, John D. The tropical American genus *Sclerolobium* Vogel (Caesalpiniaceae). Lloydia **20**: 67–118. Je [8] 1957.

Evers, Robert A. & Thieret, John W. New plant records: Illinois and Indiana. Rhodora **59**: 181. 10 Jl 1957.

Ferreyra, Ramón. Contribución al conocimiento de la flora costanera del norte peruana (Departamento de Tumbes). Bol. Soc. Argent. Bot. **6**: 194–266. Ap 1957.

Fosberg, F. R. The Maldive Islands, Indian Ocean. Atoll Res. Bull. **58**: 1–37. 15 S 1957.

Gajewski, W. A cytogenetic study on the genus *Geum* L. Pol. Tow. Bot. Monogr. **4**: 1–416. 1957.

Gilman, Elizabeth M. Grasses of the Tidewater-Piedmont region of northern Virginia and Maryland. Castanea **22**: 1–105. Mr [Au] 1957.

Gould, Frank W. Pollen size as related to polyploidy and speciation in the *Andropogon saccharoides—A. barbinodis* complex. Brittonia **9**: 71–75. 30 Jl 1957.

Hardin, James W. Studies in the Hippocastanaceae, IV. Hybridization in *Aesculus.* Rhodora **59**: 189–203. Au 1957.

Hawkes, Alex B. & Heller, A. H. Nomenclatorial notes in the *Dendrobium* alliance. Lloydia **20**: 119–132. Je [8] 1957.

Head, S. Conrade. Mitotic chromosome studies in the genus *Astragalus.* Madroño **14**: 95–106. 30 Jl 1957.

Hesse, V. F. Cleistogamy in *Mimulus Douglasii* Gray. Madroño **14**: 108, 109. 30 Jl 1957.

Howard, Richard A. Studies in the genus *Coccoloba,* IV. The species from Puerto Rico and the Virgin Islands and from the Bahama Islands. Jour. Arnold Arb. **38**: 211–242. 15 Jl 1957.

Howell, J. T. California records of *Koeleria phleoides*. Leafl. West. Bot. **8**: 180. 16 Au 1957.

Howell, J. T. The identity of *Carex albida* Bailey. Leafl. West. Bot. **8**: 178–180. 16 Au 1957.

Johnston, Ivan M. Studies in the Boraginaceae, XXIX. *Echiochilon* and related genera. Jour. Arnold Arb. **38**: 255–293. Jl 1957.

Kearney, Thomas H. A tentative key to the South American species of *Hibiscus*, L. Leafl. West. Bot. **8**: 161–168. 16 Au 1957.

Klawe, E. L. *Orobanche uniflora* L. from Yarmouth County, Nova Scotia. Canad. Field-Nat. **70**: 141. Jl–S 1956 [My 1957].

Koyama, Tetsuo. An enumeration of Hayata's Indo-Chinese collection of Cyperaceae. Contr. Inst. Bot. Univ. Montréal **70**: 5–64. Je 1957.

Krapovickas, Antonio. Tres especies nuevas de *Nototriche* (Malvaceae) de Peru. Bol. Soc. Argent. Bot. **6**: 233–238. Ap 1957.

Legrand, C. Diego. Representantes neotropicales del género *Myrceugenia*. Darwiniana **11**: 293–365. *pl. 1–5*. 31 My 1957.

Lehr, J. Harry. An annotated preliminary catalogue of the vascular flora of Rockland County, New York. Bull. Torrey Club **84**: 206–213. My–Je [25 Jl]. 310–317. Jl–Au [18 S]. 388–392. O 1957.

León, *Hermano* (Dr. J. S. Sauget) **& Alain, *Hermano*** (Dr. E. E. Liogier). Flora de Cuba. Vol. III. Dicotiledóneas: Malpighiaceae a Myrtaceae. Contr. Ocas. Mus. Hist. Nat. Col. de la Salle [Habana] **13**: 1–502. 1953. Vol. IV. Dicotiledóneas: Melastomataceae a Plantaginaceae. **16**: 1–556. 1957.

Little, Elbert L. Three proposals toward stabilization of botanical nomenclature. Taxon **6**: 188–194. 30 Au 1957.

Löve, Askell & Sarkar, Priyabrata. Chromosomes and relationships of *Koenigia islandica*. Canad. Jour. Bot. **35**: 507–514. Jl 1957.

McClure, F. A. Typification of the genera of the Bambusoideae. Taxon **6**: 199–210. 30 Au 1957.

Manning, Wayne E. A Bolivian walnut from Peru growing in Costa Rica. Brittonia **9**: 131. 30 Jl 1957.

Mariz de Lyra, Maria Emilia. Sobre *Hybanthus bigibbosus* (St. Hil.) Hafft. Rodriguésia **15**[27]: 129–135. D 1952.

Martínez Crovetto, Raul. Revisión crítica del género *Elateriopsis* (Cucurbiaceae). Darwiniana **11**: 223–243. 31 My 1957.

Mathias, Mildred E. & Constance, Lincoln. Four notable Umbelliferae from Peru. Bull. Torrey Club **84**: 189–198. My–Je [25 Jl] 1957.

Mello Filho, Luiz Emygdio de. Heliconiae novae brasilienses. Bol. Mus. Nac. [Rio de Janeiro] Bot. II. **16**: 1–7. 15 Mr 1957.

Monachino, Joseph. New plant records for southeastern United States. Castanea **22**: 110–112. Je [Au] 1957.

Monachino, Joseph. New records of western plants. Leafl. West. Bot. **8**: 176, 177. 16 Au 1957.

Montgomery, F. H. *Dentaria* in Indiana and Ohio. Rhodora **59**: 179, 180. 10 Jl 1957.

Moore, Harold E. The genus *Reinhardtia*. Principes **1**: 127–145. Jl 1957.

Moore, H. E. Synopses of various genera of Arecoideae. Gent. Herb. **8**: 481–576. *pl. 139–168*. 29 Au 1957.

Moran, Reid. Innovations in *Dudleya*. Madroño **14**: 106, 107. 30 Jl 1957.

Morley, Thomas. A revision of *Mouriri*, section *Nesophytum*. Brittonia **9**: 109–131. 30 Jl 1957.

Moul, Edwin T. Preliminary report on the flora of Onotoa Atoll, Gilbert Islands. Atoll Res. Bull. **57**: 1–48. 15 S 1957.

O'Donell, C. A. Convolvuloídeas chilenas. Bol. Soc. Argent. Bot. **6**: 143–184. Ap 1957.

Occhioni, Paulo & Rizzini, Carlos Toledo. Dialypetalanthaceae. Rodriguésia **15**[27]: 181–183. D 1952.

Pabst, G. F. J. Orchidaceae uruguayenses collectorum variorum collectae. Rodriguésia **15**[27]: 109–119. *pl. 1–7*. D 1952.

Porter, C. L. Range extensions in the genus *Peteria* (Leguminosae). Rhodora **59**: 216. Au 1957.

Price, Sam. Cytological studies in *Saccharum* and allied genera. III. Chromosome numbers in interspecific hybrids. Bot. Gaz. **118**: 146–159. Mr [Je] 1957.

Ratera, Enrique L., Ferro, Elsa N. & Cristiani, Luis Q. Observaciones sobre *Solanum angustifidum*. Bol. Soc. Argent. Bot. **6**: 185–193. Ap 1957.

Raven, Peter H. Notes on two umbelliferous weeds in California. Leafl. West. Bot. **8**: 177. 16 Au 1957.

Raven, Peter H. Plant records from San Benito County, California. Madroño **8**: 174–176. 16 Au 1957.

Ray, Peter M. & Chisaki, Haru F. Studies on *Amsinckia*. I. A synopsis of the genus, with a study of heterostyly in it. Am. Jour. Bot. 529–536. Je [Au] 1957. II. Relationships among the primitive species. 537–544. III. Aneuploid diversification in the Muricatae. 545–554.

Raymond, Marcel. The identity of *Eriophorum humile* Turcz. Contr. Inst. Bot. Univ. Montréal **70**: 95–105. Je 1957.

Raymond, Marcel. Notes sur le *Scirpus pumilis* Vahl. Contr. Inst. Bot. Univ. Montréal **70**: 83–93. Je 1957.

Raymond, Marcel. Some new or critical *Scirpus* from Indo-China (suite). Nat. Canad. **84**: 137–149. Jl 1957.

Raymond, Marcel. The identity of *Eriophorum humile* Turcz. Contr. Inst. Bot. Bot. Univ. Montréal **70**: 73–81. Je 1957.

Reed, Clyde. Contributions to the flora of Maryland. 3. *Draba ramosissima* in Maryland, with notes on the general distribution. Castanea **22**: 113–121. Je [Au] 1957.

Rock, Howard F. L. A revision of the vernal species of *Helenium* (Compositae). Rhodora **59**: 101–116. My [3 Je] 1957. 128–158. 26 Je. 168–178. 10 Jl. 203–216. Au.

Rock, J. F. Some new Hawaiian lobelioids. Occ. Pap. Bishop Mus. **22**: 35–66. 25 Jl 1957.

Rock, J. F. & Neal, Marie C. A new variety of silversword. Occ. Pap. Bishop Mus. **22**: 31–33. 22 Jl 1957.

Rzedowski, J. & Rzedowski, Graciela C. de. Notas sobre la flora y la vegetación del Estado de San Luis Potosí. V. La vegetación de la carretera San Luis Potosí—Rioverde. Acta Ci. Potos. **1**: 7–68. 1957.

Sauer, Jonathan. Recent migration and evolution of the dioecious amaranths. Evolution **11**: 11–31. Mr 1957.

Shaver, Jesse M. Some notes on *Trillium stamineum* Harbison in Tennessee. Jour. Tenn. Acad. **32**: 169–184. Jl 1957.

Shinners, Lloyd H. Against conservation of *Xanthoxylum* and *Pherosphaera*. Taxon **6**: 135–137. 21 Je 1957.

Sleumer, H. Notas sobre la flora argentina: III [*Gaultheria saltensis*, sp. nov.] Darwiniana **11**: 272–282. 31 My 1957.

Stone, Benjamin. Rediscovery of a rare lobelioid, *Brighamia insignis* forma *citrina*, in Kauai, Hawaiian Islands. Bull. Torrey Club **84**: 175–177. My–Je [25 Jl] 1957.

Troncoso, Nélida S. El género *Neosparton* (Verbenaceae). Darwiniana **11**: 163–192. 31 My 1957.

Voss, Edward G. Observations on the Michigan flora—VI. Distribution records of some angiosperms new, rare, or misinterpreted in the state. Brittonia **9**: 83–101. 30 Jl 1957.

Wurdack, J. J. Certamen Melastomataceis—IV. Brittonia **9**: 101–109. 30 Jl 1957.

PALEOBOTANY

Livingstone, D. A. Pollen analysis of a valley fill near Umiat, Alaska. Am. Jour. Sci. **255**: 254–260. Ap 1957.

Rigg, George B. & Gould, Howard R. Age of Glacier Peak eruption and chronology of post-glacial peat deposits in Washington and surrounding areas. Am. Jour. Sci. **255**: 341–363. My 1957.

ECOLOGY AND PLANT GEOGRAPHY

(See also under Bryophytes: **Schuster**)

Dyksterhuis, E. J. The savannah concept and its use. Ecology **38**: 435–442. Jl 1957.

England, Celia McElroy & Rice, Elroy L. A comparison of the soil fungi of a tall-grass prairie and of an abandoned field in central Oklahoma. Bot. Gaz. **118**: 186–190. Mr [Je] 1957.

Galiano, Emilio Fernandez. Quelques associations de la classe des Litorelletea dans la Province de Québec. Contr. Inst. Bot. Univ. Montréal **70**: 107–118. Jl 1957.

Heady, Harold F. The measurement and value of plant height in the study of herbaceous vegetation. Ecology **38**: 313–320. Ap 1957.

Keever, Catherine. Establishment of *Grimmia laevigata* on bare granite. Ecology **38**: 422–429. Jl 1957.

Monk, Carl D. Plant communities of Hutcheson Memorial Forest based on shrub distribution. Bull. Torrey Club **84**: 198–206. My–Je [25 Jl] 1957.

Nelson, Thomas C. The original forests of the Georgia Piedmont. Ecology **38**: 390–397. Jl 1957.

Ritchie, J. C. The vegetation of northern Manitoba. II. A prisere on Hudson Bay lowlands. Ecology **38**: 429–435. Jl 1957.

Shields, Lora Mangum, Mitchell, Charles & Drouet, Francis. Alga- and lichen-stabilized surface crusts as soil nitrogen sources. Am. Jour. Bot. **44**: 489–498. Je [Au] 1957.

Soriano, Alberto. Aspectos ecológicos y pasturiles de la vegetación patagonica relacionados con su estado y capacidad de recuperación. Revista Invest. Agr. [Buenos Aires] **10**: 344–372. 28 D 1956.

Soriano, Alberto. Los distritos florísticos de la Provincia Patagonica. Revista Invest. Agr. [Buenos Aires] **10**: 323–348. 28 D 1956.

MORPHOLOGY

(including anatomy and cytology in part)

(See also under Spermatophytes: **Ray & Chisaki**; under Phytopathology: **Smith & McWhorter**)

Bailey, I. W. Aggregations of microfibrils and their orientations in the secondary wall of coniferous tracheids. Am. Jour. Bot. **44**: 415–418. My [22 Jl] 1957.

Bailey, I. W. The potentialities and limitations of wood anatomy in the study of the phylogeny and classification of angiosperms. Jour. Arnold Arb. **38**: 243–254. 15 Jl 1957.

Bannan, M. W. Girth increase in white cedar stems of irregular form. Canad. Jour. Bot. **35**: 425–434. *pl. 1.* Jl 1957.

Bistis, George. Sexuality in *Ascobolus stercorarius.* II. Preliminary experiments on various aspects of the sexual process. Am. Jour. Bot. **44**: 436–443. My [22 Jl] 1957.

Bryan, George S. & Evans, Richard I. Types of development from the central nucleus of *Zamia umbrosa.* Am. Jour. Bot. **44**: 404–415. My [22 Jl] 1957.

Dodge, B. O. Rib formation in ascospores of *Neurospora* and questions of terminology. Bull. Torrey Club **84**: 182–188. My–Je [25 Jl] 1957.

Dnyansagar, V. R. Embryological studies in the Leguminosae. V. *Prosopis spicigera* and *Desmanthus virgatus.* Bot. Gaz. **118**: 180–186. Mr [Je] 1957.

Duff, G. H. & Nolan, Norah J. Growth and morphogenesis in the Canadian forest species. II. Specific increments and their relation to the quantity and activity of growth in *Pinus resinosa* Ait. Canad. Jour. Bot. **35**: 527–572. Jl 1957.

Flint, Franklin F. Megasporogenesis and megagametogenesis in *Fothergilla gardeni* Murr. and *Fothergilla major* Lodd. Trans. Am. Micr. Soc. **76**: 307–311. Jl 1957.

Fogelberg, S. O., Struckmeyer, B. Esther & Roberts, R. Y. Morphological variations of mitochondria in the presence of plant tumors. Am. Jour. Bot. **44**: 454–459. My [22 Jl] 1957.

Grant, William F. A cytogenetic study in the Acanthaceae. Brittonia **8**: 121–149. 8 Ap 1955.

Hauke, Richard L. The stomatal apparatus of *Equisetum.* Bull. Torrey Club **84**: 178–181. My–Je [25 Jl] 1957.

Lampton, Robert K. Floral morphology in *Asimina triloba* Dunal I. Development of ovule and embryo sac. Bull. Torrey Club **84**: 151–156. My–Je [25 Jl] 1957.

Mason, Herbert L. The concept of the flower and the theory of homology. Madroño **14**: 81–95. 30 Jl 1957.

Milanez, F. R. Sôbre os núcleos dos lactieíferos de *Euphorbia phosphorea* Mart. Rodriguésia **15**[27]: 163–175. D 1952.

Murray, Beatrice E. The ontogeny of adventitious stems on roots of creeping-rooted alfalfa. Canad. Jour. Bot. **35**: 463–475. *pl. 1–9.* Jl 1957.

Norris, Richard Earl. Morphological studies on the Kallymeniaceae. Univ. Calif. Publ. Bot. **28**: 251–334. *pl. 28–40.* 1957.

Persidsky, Maxim D. & Duncan, Robert E. Liberation of nuclei and achromatic figures from maize endosperm. Stain Tech. **32**: 117–121. My 1957.

Riedhart, Joseph M. & Guard, Arthur T. On the anatomy of the roots of apple seedlings. Bot. Gaz. **118**: 191–194. Mr [Je] 1957.

Sagawa, Yoneo & Mehlquist, A. L. The mechanism responsible for some X-ray induced changes in flower color of the carnation, *Dianthus caryophyllus.* Am. Jour. Bot. **44**: 397–403. My [22 Jl] 1957.

Schnack, Benno & Fehleisen, Saul. Citomixis en *Bouchea fluminensis* (Velloso) Moldenke (Verbenaceae). Darwiniana **11**: 244–255. 31 My 1957.

Setterfield, G. & Bayley, S. T. Studies on the mechanism of deposition and extension of primary cell walls. Canad. Jour. Bot. **35**: 435–444. *pl. 1–4.* Jl 1957.

Stewart, Robert B. The morphology of the sclerotium of *Claviceps paspali.* Phytopathology **47**: 444, 445. 22 Jl 1957.

Spencer, J. L. & Winters, H. F. Compatibility, pollination, and disease in relation to fruit yields of *Strophanthus intermedius* in Puerto Rico. Bot. Gaz. **118**: 194–198. Mr [Je] 1957.

Sun, C. N. Histogenesis of the leaf and structure of the shoot apex in *Glycine max* (L.) Merrill. Bull. Torrey Club **84**: 163–179. My–Je [25 Jl] 1957.

Taylor, A. R. A. Studies of the development of *Zostera marina* L. Canad. Jour. Bot. **35**: 477–499. *pl. 1–3.* Jl 1957.

Tucker, Shirley C. Ontogeny of the etiolated seedling mesocotyl of *Zea mays.* Bot. Gaz. **118**: 160–174. Mr [Je] 1957.

Wilson, K. Extension growth in primary cell walls with special reference to *Elodea canadensis.* Ann. Bot. II. **21**: 1–11. *pl. 1.* Ja 1957.

GENETICS
(including Cytogenetics)

(See also under Morphology: **Sagawa & Mehlquist**; under Phytopathology: **Boone & Keitt**)

Bosemark, Nils Olof. Further studies on accessory chromosomes in grasses. Hereditas **43**: 236–297. 10 Jl 1947.

Goplen, B. P., Greenshields, J. E. R. & Baenziger, H. The inheritance of coumarin in sweet clover. Canad. Jour. Bot. **35**: 583–593. Jl 1957.

Marks, G. E. Telocentric chromosomes. Am. Nat. **91**: 223–232. 10 Jl 1957.

McNeal, F. H., Lebsock, K. L., Luginbill, P. & Noble, E. B. Segregation for stem solidness in crosses of rescue and four Portuguese wheats. Agron. Jour. **49**: 246–248. My 1957.

Middlekauff, James E. *et al.* Gene control of resistance vs. sensitivity to actidione in *Saccharoymces.* Genetics **42**: 66–71. Ja [19 Ap] 1957.

Nyquist, W. E. Inheritance of resistance to leaf rust in hybrids involving a common wheat strain derived from *Triticum timopheevi.* Agron. Jour. **49**: 240–243. My 1957.

Soriano, J. D. The genus *Collinsia.* IV. The cytogenetics of colchicine-induced reciprocal translocations in *C. heterophylla.* Bot. Gaz. **118**: 139–145. Mr [Je] 1957.

Storey, W. B. Fertility and sterility in *Vanda.* Am. Orchid Soc. Bull. **26**: 472–477. Jl 1957.

Taylor, J. Herbert. The time and mode of duplication of chromosomes. Am. Nat. **91**: 201–221. 10 Jl 1957.

Walters, Marta Sherman. Studies of spontaneous chromosome breakage in interspecific hybrids of *Bromus.* Univ. Calif. Publ. Bot. **28**: 335–447. *pl. 41–61.* 6 Je 1957.

Zimmer, K. G. A physicist's comments on some recent papers on radiation-genetics. Hereditas **43**: 201–210. 10 Jl 1957.

Zimmerman, L. H. The relationship of a dwarf-internode gene to several important agronomic characters in castorbeans. Agron. Jour. **49**: 251–254. My 1957.

Zuck, Theodore T. Pentaploid *Cattleya* hybrids and their successful breeding. Am. Orchid Soc. Bull. **26**: 477–479, 503, 504. Jl 1957.

PLANT PHYSIOLOGY

(See also under Fungi: **Shields et al.**)

Abeygunawardena, D. V. W. & Wood, R. K. S. Factors affecting the germination of sclerotia and mycelial growth of *Sclerotium rolfsii* Sacc. Brit. Mycol. Soc. Trans. **40**: 221–231. Je 1957.

Cantino, Edward C., Lovett, James & Horenstein, E. A. Chitin synthesis and nitrogen metabolism during differentiation in *Blastocladiella emersonii*. Am. Jour. Bot. **44**: 498–505. Je [Au] 1957.

Dugger, W. M. Autoradiography with plant tissue. Bot. Rev. **23**: 351–387. Je 1957.

Eaton, Frank M. & Ergyle, David R. Mineral nutrition of the cotton plant. Plant Physiol. **32**: 169–175. My [Jl] 1957.

Etheridge, D. E. Comparative studies of *Coryne sarcoides* (Jacq.) Tul. and two species of wood-destroying fungi. Canad. Jour. Bot. **35**: 595–603. *pl. 1*. Jl 1957.

Fensom, D. S. The bio-electric potentials of plants and their functional significance. I. An electrokinetic theory of transport. Canad. Jour. Bot. **35**: 573–582. Jl 1957.

Hildebrandt, Albert C., Riker, A. J. & Muir, Elizabeth. Growth in vitro of marigold and tobacco tissue with nucleic acids and related compounds. Plant Physiol. **32**: 231–236. My [Jl] 1957.

Johnson, G. T. Fatty acids as carbon sources for the growth of *Spicaria violacea*. Mycologia **49**: 172–177. 30 Ap 1957.

Kunitake, George M., Saltman, Paul & Lang, Anton. The products of CO_2 dark fixation in leaves of long- and short-day treated *Kalanchoe blossfeldiana*. Plant Physiol. **32**: 201–203. My [Jl] 1957.

Levitt, J. The role of cell sap concentration in frost hardiness. Plant Physiol. **32**: 237–239. My [Jl] 1957.

Lingappa, Yamuna. Tissue cultures of *Solanum tuberosum* and *Ipomoea pandurata*. Am. Jour. Bot. **44**: 419–423. My [22 Jl] 1957.

Lockhart, James A. Studies on the organ of production of the natural gibberellin factor in higher plants. Plant Physiol. **32**: 204–207. My [Jl] 1957.

Lockhart, James A. & Weintraub, Robert L. Influence of 2, 4-dichlorophenoxyacetic acid on auxin content of bean seedlings. Am. Jour. Bot. **44**: 424–428. My [22 Jl] 1957.

Mer, C. L. A re-examination of the supposed effect of riboflavin on growth. Plant Physiol. **32**: 175–185. My [Jl] 1957.

Newton, William. The utilization of single organic nitrogen compounds by wheat seedlings and by *Phytophthora parasitica*. Canad. Jour. Bot. **35**: 445–448. Jl 1957.

Ordin, Lawrence & Bonner, James. Effect of galactose on growth and metabolism of *Avena* coleoptile sections. Plant Physiol. **32**: 212–215. My [Jl] 1957.

Ordin, Lawrence, Cleland, Robert & Bonner, James. Methyl esterification of cell wall constituents under the influence of auxin. Plant Physiol. **32**: 216–220. My [Jl] 1957.

Saltman, Paul *et al.* The dark fixation of CO_2 by succulent leaves: metabolic changes subsequent to initial fixation. Plant Physiol. **32**: 197–200. My [Jl] 1957.

Samborski, D. J. & Shaw, Michael. The physiology of host-parasite relations. IV. The effect of maleic hydrazide and indoleacetic acid on the rust resistance of khapli and little club wheats. Canad. Jour. Bot. **35**: 449–455. *pl. 1, 2.* Jl 1957. IV A. The effect of maleic hydrazide on the carbohydrate, nitrogen, and free amino acid content of the first leaf of khapli wheat. 457–461.

Saunders, George W. Interrelations of dissolved organic matter and phytoplankton. Bot. Rev. **23**: 389–409. Je 1957.

Skoropad, W. P. & Arny, D. C. The influence of amino acids on the growth of two strains of *Helminthosporium gramineum*. Phytopathology **47**: 249–252. My [17 Je] 1957.

Slocum, Donald H. & Little, John E. Growth stimulation of *Avena* coleoptiles. Plant Physiol. **32**: 192–196. My [Jl] 1957.

Smith, Harriet J., McIlrath, Wayne J. & Bogorad, Lawrence. Some effects of iron deficiency on flowering *Xanthium*. Bot. Gaz. **118**: 174–179. Mr [Je] 1957.

Switzer, Clayton M. & Smith, Frederick G. Factors affecting oxidation and phosphorylation by soybean mitochondria. Canad. Jour. Bot. **35**: 515–525. Jl 1957.

Tagawa, Takashi & Bonner, James. Mechanical properties of the *Avena* coleoptile as related to auxin and to ionic interactions. Plant Physiol. **32**: 207–212. My [Jl] 1957.

Verdcourt, Bernard. A note on the changes in color in the *Aspergillus niger* group due to the proximity of a degenerate *Mucor*. Mycologia **49**: 299, 300. 30 Ap 1957.

Vickery, Hubert Bradford. The formation of starch and the behavior of isocitric acid in excised leaves of *Bryophyllum calycinum* cultured in darkness. Plant Physiol. **32**: 220–224. My [Jl] 1957.

Viglierchio, D. R. & Went, F. W. Plant growth under controlled conditions. IX. Growth and fruiting of the Kentucky wonder bean (*Phaseolus vulgaris*). Am. Jour. Bot. **44**: 449–453. My [22 Jl] 1957.

Waggoner, Paul E. & Dimond, A. E. Altering the pigments produced by tyrosinase and ortho-hydroxyphenols with a meta-hydroxy-phenol, 4-chlororesorcinol. Plant Physiol. **32**: 240–242. My [Jl] 1957.

Weller, Lowell E., Ball, Charles D. & Sell, Harold M. Studies of maleic hydrazide interactions with thiol compounds. Plant Physiol. **32**: 146–148. Mr [My] 1957.

Wildon, Carrick E., Hamner, Charles L. & Bass, Samuel T. The effect of 2,4-dichlorophenoxyacetic acid on the accumulation of mineral elements in tobacco plants. Plant Physiol. **32**: 243, 244. My [Jl] 1957.

Yocum, Conrad S. & Hackett, David P. Participation of cytochromes in the respiration of the aroid spadix. Plant Physiol. **32**: 186–191. My [Jl] 1957.

PHYTOPATHOLOGY

(See also under Morphology: **Fogelberg et al; Spencer & Winters;** under Physiology: **Abeygunawardena & Wood; Etheridge; Samborski & Shaw;** under Genetics: **Nyquist**)

Anzalone, Louis & Plakidas, A. G. *Cercospora* [*photiniae-serrulatae* sp. nov.] leaf-spot of *Photinia serrulata*. Mycologia **49**: 412–416. 28 Je 1957.

Baggett, James R. Effects of genetic segregation in *Phaseolus vulgaris* on the symptoms induced by bean yellow mosaic virus. Phytopathology **47**: 365–368. 28 Je 1957.

Benda, G. T. A. & Naylor, Aubrey W. On the tobacco ringspot disease. II. The delayed local lesions. Am. Jour. Bot. **44**: 443–448. My [22 Jl] 1957.

Blodgett, Earle C. Prune crinkle leaf. Phytopathology **47**: 418–420. 22 Jl 1957.

Boone, D. M. & Keitt, G. W. *Venturia inaequalis* (Cke.) Wint. XII. Genes controlling pathogenicity of wild-type lines. Phytopathology **47**: 403–409. 22 Jl 1957.

Brierly, Philip & Smith, Floyd F. Symptoms of chrysanthemum flower distortion, dodder transmission of the virus, and heat cure of infected plants. Phytopathology **47**: 448–450. 22 Jl 1957.

Daines, Robert H. & Gray, Reed. Streptomycin foliage sprays and control of bacterial spot of peach. Phytopathology **47**: 448. 22 Jl 1957.

Fisher, Fran. E. Control of citrus fruit russet in Florida with zineb. Phytopathology **47**: 433–437. 22 Jl 1957.

Gäumann, Ernst. Fusaric acid as a wilt toxin. Phytopathology **47**: 342–357. 28 Je 1957.

Johnson, Howard W. Lamont, a new variety of rescuegrass resistant to head smut. Phytopathology **47**: 409–412. 22 Jl 1957.

Király, Z. & Farkas, G. L. Decrease in glycolic acid oxidase activity of wheat leaves infected with *Puccinia graminis* var. *tritici*. Phytopathology **47**: 277, 278. My [17 Je] 1957.

Kreitlow, K. W., Hunt, O. J. & Wilkins, H. L. The effect of virus infection on yield and chemical composition of Ladino clover. Phytopathology **47**: 390–394. 22 Jl 1957.

Ludwig, R. A. Toxin production by *Helminthosporium sativum* P. K. & B. and its significance in disease development. Canad. Jour. Bot. **35**: 291–303. *pl. 1, 2*. My 1957.

McClellan, W. D., Taylor, Edgar A. & Smith, Floyd F. Relation of fungicide and miticide treatments to winter injury and spring blackspot development of roses. Phytopathology **47**: 357–360. 28 Je 1957.

McClellan, W. D., Taylor, Edgar A. & Smith, Floyd F. Synergism between copper and sulfur in dust mixtures for the control of rose blackspot. Phytopathology **47**: 240, 241. Ap [16 My] 1957.

MacNeill, Blair H. & Zalasky, Harry. Histological study of host-parasite relationships between *Septoria glycines* Hemmi and soybean leaves and pods. Canad. Jour. Bot. **35**: 501–505. Jl 1957.

McWhorter, Frank P. Association between *Rhizoctonia* and yellow coloration of Easter lily bulbs. Phytopathology **47**: 447, 448. 22 Jl 1957.

Nelson, Paul E. Pathogenicity of *Idriella lunata* on strawberry. Phytopathology **47**: 438–443. 22 Jl 1957.

Panzer, James D. Osmotic pressure and plant virus local lesions. Phytopathology **47**: 337–341. 28 Je 1957.

Patterson, F. L., Shands, R. G. & Dickson, J. G. Temperature and seasonal effects on seedling reactions of barley varieties and three races of *Puccinia graminis* f. sp. *tritici*. Phytopathology **47**: 395–402. 22 Jl 1957.

Pringle, Ross B. & Braun, Armin C. The isolation of the toxin of *Helminthosporium victoriae*. Phytopathology **47**: 369–371. 28 Je 1957.

Rishbeth, J. *Fusarium* wilt of bananas in Jamaica. II. Some aspects of host-parasite relationships. Ann. Bot. II. **21**: 215–245. Ap 1957.

Scheffer, R. P. Analysis of *Fusarium* resistance in tomato by grafting experiments. Phytopathology **47**: 328–331. 28 Je 1957.

Sharp, Eugene L. & Smith, Frederick G. Further study of the preservation of *Puccinia* uredospores. Phytopathology **47**: 423–429. 22 Jl 1957.

Sinclair, J. B., Geil, P. H. & Kaesberg, Paul. Biophysical studies of wild cucumber mosaic virus. Phytopathology **47**: 372–377. 28 Je 1957.

Smith, Frank H. & McWhorter, Frank P. Anatomical effects of tomato ringspot virus in *Vicia faba*. Am. Jour. Bot. **44**: 470–477. Je [Au] 1957.

Smith, Glenn E. Inhibition of *Fusarium oxysporum* f. *lycopersici* by a species of *Micromonospora* isolated from tomato. Phytopathology **47**: 429–432. 22 Jl 1957.

Smith, M. A. & Ramsey, G. B. Fruit decay and twig cankers on peach. Phytopathology **47**: 445, 446. 22 Jl 1957.

Soraci, F. A. *et al.* Symposium on foreign plant quarantine and regulatory administration. Phytopathology **47**: 381–389. 22 Jl 1957.

Stewart, Robert B. Leaf blight and stem dieback of coffee caused by an undescribed species of *Ascochyta* [*tarda*]. Mycologia **49**: 430–433. 28 Je 1957.

Thaung, Maung Mya & Walker, J. C. Studies on bacterial blight of lima bean. Phytopathology **47**: 413–417. 22 Jl 1957.

Tuite, John F. & Christensen, Clyde M. Grain storage studies XXIII. Time of invasion of wheat seed by various species of *Aspergillus* responsible for deterioration of stored grain, and source of inoculum of these fungi. Phytopathology **47**: 265–268. My [17 Je] 1957. XXIV. Moisture content of wheat seed in relation to invasion of the seed by species of the *Aspergillus glaucus* group and effect of invasion upon germination of the seed. 323–327. 28 Je 1957.

Ullstrup, Arnold J. & Miles, S. R. The effects of some leaf blights of corn on grain yield. Phytopathology **47**: 331–336. 28 Je 1957.

Whitehead, Marvin D. Sorghum grain, a medium suitable for the increase of inoculum for studies of soil-borne and certain other fungi. Phytopathology **47**: 450. 22 Jl 1957.

Zuckerman, Bert M. Effects of X rays on the germination of conidia of the oak wilt fungus. Phytopathology **47**: 361–364. 28 Je 1957.

GENERAL BOTANY
(including biography)

Anderson, Edgar. An experimental investigation of judgments concerning genera and species. Evolution **11**: 260–262. Je 1957.

Anon. John Hobart Hoskins (1896–1957). Lloydia **20**: iii–vi. *port.* Mr [Au] 1957.

Banning, Anne. Elsie Margaret Groves, 1897–1956. Canad. Field-Nat. **71**: 9. *port.* Ja–Mr [Jl] 1957.

Barkley, Fred A. Carlos Alberto O'Donell, 1912–1954. Brittonia **8**: 115–120. 8 Ap 1955.

Buchinger, Maria. Suggestions to maintain the stability of nomenclature at the specific level. Taxon **6**: 195–197. 30 Au 1957.

Chinard, Gilbert. André and François-André Michaux and their predecessors. An essay on early botanical exchanges between America and France. Proc. Am. Philos. Soc. **101**: 344–361. 16 Au 1957.

Davis, Mervyn T. A guide and an analysis of Engler's "Das Pflanzenreich." Taxon **6**: 161–182. 1 Au 1957.

Dayton, William A. Anent *Corydalis caseana* and Eliphalet Lewis Case (1843–1925). Leafl. West. Bot. **8**: 170–174. 16 Au 1957.

Dayton, W. A. & Blake, S. F. Ivar Tidestrom, 1864–1956. Rhodora **59**: 161–168. *port.* 10 Jl 1957.

Guimarães, Adii. Barbosa Rodrigues. Rodriguésia **15**[27]: 191–212. D 1952.

Melchior, H. Reinhard Knuth, 1874–1957. Taxon **6**: 185, 186. 30 Au 1957.

Robbins, William J. French botanists and the flora of the northeastern United States: J. G. Milbert and Elias Durand. Proc. Am. Philos. Soc. **101**: 362–368. 16 Au 1957.

Rostand, Jean. Lucien Cuénot. [transl. from French.] Genetics **42**: 1–6. *port.* Ja [19 Ap] 1957.

Schramm, J. R. Influence—past and present—of François-André Michaux on forestry and forest research in America. Proc. Am. Philos. Soc. **101**: 336–343. 16 Au 1957.

Stearn, William T. Achille Richard's "Mémoire sur la famille des rubiacées." Taxon **6**: 186–188. 30 Au 1957.

Stevenson, John A. Cornelius Lott Shear, 1865–1956. Phytopathology **47**: 321, 322. 28 Je 1957.

Walker, Egbert H. Dr. Elmer D. Merrill, 1876–1956. Pacif. Sci. **11**: 135, 136. Ja 1957.

Walker, J. C. Benjamin Minge Duggar, 1872–1956. Phytopathology **47**: 379, 380. 22 Jl 1957.

Wood, R. D. Hand-sorted punched cards in taxonomic research. Brittonia **9**: 65–69. 30 Jl 1957.

INDEX TO VOLUME 84

Names of contributors are printed in CAPITALS. Names of new genera, species, varieties, forms and combinations are printed in **bold face**. Numbers in *italic* refer to pages on which the name is listed as a synonym. Numbers in **bold face** refer to pages on which the name is accompanied by a description or illustration.

Abies balsamea, 57; *lasiocarpa*, 204
Acacia, 69
Acer platanoides, 199, 424; *rubrum*, 199, 424; *saccharum*, 199
Aconitum noveboracense, 57
Actaea pachypoda, 57; rubra, 57
Aerobacter, 370, 381
Agrostis alba, 204
ALBERTSON, F. W.: Grasslands of the Great Plains: Their nature and use (Review) 138
Allium cepa, 356, 357, 358, 359; *porrum*, 171
ANDERSON, PATRICIA: Two genera of molds with low temperature growth requirements, 31
ANDREWS, JR. HENRY N.: A study of *Botryopteris globosa* Darrah, 252
Andropogon, 51, 107, 161; *scoparius*, 51, 204
Anemonella thalictroides, 201
Annona muricata, 155 *squamosa*, 155
Annotated preliminary catalogue of the vascular flora of Rockland County, New York, 48, 126, 206, 310, 388, 450; Pinaceae to Orchidaceae, 48–56; Saururaceae to Rosaceae, 126–134; Leguminosae to Pyrolaceae, 206–213; Ericaceae to Campanulaceae, 310–316; Compositae 388–392; additions and corrections, 450–452
Anomodon striatus, *345*; var. *saxicola*, *346*
Anthoxanthum, 157
Arachis, 70
Arenaria stricta, 452
Argythamnia, 421, 423; **acaulis, 422**; *aphoroides*, 422; *argyraea*, 422, 423; **cuneifolia, 422; haitiensis, 423; Jablonszkyana, 423; malphighipila, 423**; *mercurialina*, 422: var. *mercurialina*, 422: var. *pilosissima*, 422; **rhizantha, 423; rosularis, 423; salina, 423; Sellowiana, 423; simulans, 421,** 422
Argythamnia subgenus *Ditaxis*, New names in, 421
Arisaema triphyllum, 201
Armillaria mellea, 428
Asclepias fusca, 47; *fuscatum*, 47; *lutea*, 47; *nigra*, 47
Ascobolus furfuraceus, 183; *striato-punctatus*, 185
Ascophora pulchra, *33*, 36
Ascospores of *Neurospora*, rib formation and questions of terminology, 182
Ascospores, Oil drops and DeBary "Bubbles" in, 431
Asimina triloba, 151, 152, 153, 154, 155
Asplenium ebenoides, 79, 80, 87, 89; *platyneuron*, 80, 83, 85, 89; *rhizophyllum*, 80, 85, 89
Aster, 204
Azorella, 189; *multifida*, 189; *pedunculata*, 190; *pulvinata*, 189, **190**
BACKUS, EDWARD J.: (Obituary of Benjamin Minge Duggar), 308
BALDWIN, J. T. AND BERNICE M. SPEESE: *Flagellaria guineensis*, 90
Ballocephala sphaerospora, 274
Basidiobolus, 269; *ranarum*, 280
BERGER, C. A.: Some cytological effects of gibberellin, 356
Betula nigra, 203
Betulae, 271
Bidens bipinnata, 57; *trichosperma*, 57
Book Reviews, 58, 138, 218, 318, 395, 452
BORNSIDE, GEORGE H.: Decomposition of marsh grass by aerobic marine bacteria, 366
Botanical literature, Index to American, 59, 141, 219, 324, 398, 459
Botryopteris, 252, 253, 254, 266; *fecunda*, 253; *forensis*, 255, 264; *globosa*, 252, 253, 255, 256, 257, **259, 261, 262, 263,** 264, 265, 266; *illinoensis*, 253; *spinosa*, 253; *trisecta*, 254, 266
Botrytis jonesii, *38*
BOUCK, G. B. AND E. MORGAN: The occurrence of *Codium* in Long Island waters, 384
Bouteloua, 107
Brachythecium, 341, 342, 352; *plicatum*, 340; *salebrosum*, 352; **Tricholeskea, 342**
Brighamia, 175, 176; *insignis* forma *citrina*, 175
Briza, 157
BROWN, WALTER V.: Extra-ovular development of embryos in two grass species, 361
BUELL, HELEN F.: (Review) 458
Bulbothmnadium, 32, 36; *elegans*, *33*, 36; *pulchrum*, *33*; *pulchrum* var. *variabile*, *33*, 36

BURKHOLDER, PAUL R. AND GEORGE H. BORNSIDE: Decomposition of marsh grass by aerobic marine bacteria, 366
By-laws of the Torrey Botanical Club, 124
Cakile edentula, 57
Calamagrostis, 50, 107, 119; *canadensis*, 50
Calla, 53; *palustris*, 53, 452
Calopogon, 56; *puchellus*, 56
CAMP, WENDELL H.: (Review) 397
Cananga odorata, 155
CAPPELLINI, RAYMOND: (Book Review) 458
Capsicum, 413; *annuum*, 413, 416, 417, 418, 419, 420; var. *baccatum*, 418 var. *minus*, 418; *baccatum*, 418, 419; *frutescens*, 413, 415, 416, 417, 419, 420; var. *baccatum*, 418; *luteum*, 415, *microcarpum*, 419, 420; *pendulum*, 413, 416, 419, 420; *pubescens*, 413, 416, 420; *sinense*, *413*, *414*, 415, 416, 417, 418, 419, 420; *umbilicatum*, 415
Capsicum sinense Jacq., Taxonomy of and the geographic distribution of the cultivated *Capsicum species*, 413
Carex pensylvanica, 201, 202, 203
Carya, 168; *buckleyi* var. *Arkansana*, 171; *ovalis*, 199; *ovata*, 199
Cassia glauca, 69
CELARIER, ROBERT P.: *Elyonurus argenteus*, a South African grass with five chromosome pairs, 157
Cenchrus, 107, 119; *setigerus*, 107
Cercis, 69
Chaetochloa, 94; *gibbosa*, 99; *leucopila*, 101; *macrostachya*, 99; *polystachya*, 103; *rigida*, 101; *villosissima*, 95
Chaetocladium, 31, 32, 37, 39, 41, 43; *brefeldii*, 35, **39**; *brefeldii* var. *macrosporum* 39; *fresenianum*, *38*; *fresenii*, *38*; *jonesii*, **38**; var. *macrosporus* 40
Chaetostylum, 31, 32, 33, 34, 36, 37, 43; *circinana*, 37; *echinatum*, *33*; *fresenii*, 31, 32, 33, 34, 36, 38, 39; *fresenii* var. *macrosporum*, *33*, 36
Chamaeraphsis macrostachya, 99; *setosa* var. *macrostachya*, 99
CHAMPNEYS, HARCOURT P.: Encylopedia of roses and rose culture (Review), 322
Chateachloa scheelei, 103
Chelidonium, 313
Chlorochytrium gloeophilum, 453
Cicer arietinum, 69
Circaea quadrisulcata, 201
Claytonia virginica, 201
Clermontia, 175
Clethra alnifolia, 452
COBB, BOUGHTON: A field guide to ferns (Review), 321
Codium, 384, 385, 386, 387; *fragile*, 387; subsp. *tomentoides*, 384
Codium, the occurrence of, in Long Island waters, 384
CODY, W. J.; Ferns of the Ottawa District (Review), 322
Coix, 157, 161
Cokeromyces, 31
Coleus blumei, 233, 234
Conidiobolus, 268, 269; *nanodes*, 271; **paulus**, **269**, **270**, 271, **272**, 273, 274, 277, 279, 280; *pumilus*, 271, 273; *rugosus*, 280; **undulatus**, **275**, **276**, 277, **278**, 279, 280
CONSTANCE, LINCOLN: (Review), 58; Four notable Umbelliferae from Peru, 189
Constitution and By-laws of the Torrey Botanical Club, 122
Cordyceps, 243; *agariciformia*, 248; *canadensis*, 243, **244**, 245, 249, 250; *capitata*, 243, **244**, 245, 246, **247**, 248, 249, 250; var. *canadensis*, 246; *fracta*, 244, 245, 250, 251; *intermedia*, 243, 251; *japonica*, 243, 244, 245, **246**, 247; *jezoensis*, 243, 247, 250; *nigriceps*, 243, *247*, 248; parasitica, 245; **tenuispora**, **244**, 245, *ophioglossoides*, 243, **244**, **245**, 249, 250; **247**; *umemurai*, *246*; **valliformis**, 245, **250**, 251
Cornus canadensis, 57; *florida*, 199
Cotopaxia, 197
COUPLAND, R. T.: (Review), 138
Crataegus, 204
CROCKETT, LAWRENCE J.: A study of the tunica corpus and anneun initial of irradiated and normal stem apices of *Nicotiana tabacum* L., 229
CURTIS, WINIFRED M.: The student's flora of Tasmania. Part 1. (Review), 58
Cuscuta, 429; *brevistyla*, 430; *epithymum*, 430; **rhodesiana**, **429**
Cuscuta, new from South Africa, 429
Cyanea, 175
Cynanachum, 47; *barbatum*, 47; *fuscatum*, 47; *luteum*, 47; *medium*, 47; *nigrum*, 47; *Vincetoxicum*, 47
Cypripedium acaule, 452; *calceolus* var. *pubescens*, 452
DANSEREAU, PIERRE: Biogeography: An ecological perspective (Review), 395
Decodon verticillatus, 452
Delacroixia coronata, 268
Delissea, 175

DESJARDINS, PAUL R.: A glass support for plant tissue pieces cultured in liquid medium, 29
Digitaria valida, 361, 362, 363, 364
Diseases of field crops (Review), 457
Ditaxis, 423; *acaulis*, 422; *cuneifolia*, 423; *Jablonszkyana*, 423; *malphighipila*, 423; *rhizantha*, 423; *rosularis*, 423; *salina*, 423; *Sellowiana*, 423
DODGE, B. O.: Rib formation in ascospores of *Neurospora* and questions of terminology, 182; Oil drops and DeBary "bubbles" in ascospores, 431
Drawings of British plants (Review), 458
DRECHSLER, CHARLES: Two small species of *Conidiobolus* forming lateral zygospores, 268
Dulichium, 452
DUGGAR, BENJAMIN MINGE: (Obituary), 308
Ecology of the Watchung Reservation (Review), 456
Elaphomyces, 243, 247; *appalachensis*, 251; *cervinus*, 246, 247, 250; *granulatus*, 246, 247, 249; *japonica*, 246; *muricatus*, 246, 249; sp., 246, 247, 249, 250; *variegatus*, 246
Elyonurus, 157, 158, 161; *argenteus*, 157, 159, 160, 161
Elyonurus argenteus, a South African grass with five chromosome pairs, 157
EMERY, WILLIAM H. P.: A cyto-taxonomic study of *Setaria macrostachya* (Gramineae) and its relatives in the Southwestern United States and Mexico, 94; A study of reproduction in *Setaria macrostachya* and its relatives, 106; AND WALTER V. BROWN: Extra-ovular development of embryos in two grass species, 361
Empusa, 269
Entomophthora, 269
Equisetum, 178, 179, 180
Equisetum, the stomatal apparatus of, 178
Eryngium eurycephalum, 194, 196; *Delarocheanum*, 194, 196; *horridum*, 194; *Humboldtii*, 194; *Malmeanum*, 194, 196; *megapotamicum*, 194, 196; *paniculatum*, 194, 196; **Rauhianum, 192, 193,** 196
Eu-Pseudoleskea, 286
Extra-ovular development in two grass species, 361
Fagus grandifolia, 199
FAIRBROTHERS, DAVID E.: (Review), 320
FASSETT, NORMAN C.: A manual of aquatic plants (Review), 320
Festuca obtusa, 452
Field trip reports, 56, 134, 318, 394, 452
Fingerhuthia africana, 361, 362, 363, 364
Flagellaria, 90, 92, 93; *guineensis*, 90, **91,** 92
Flavobacterium, 370, 381
Floral morphology in *Asimina triloba* Dunal I. Development of ovule and embryo sac, 151
Fraxinus americana, 199
Galium, 361; *aparine*, 201
Ganoderma, 426, 427; *lucidum*, 424, 425, 426, 427, 428
Gaultheria hispidula, 57
Gelasinospora tetrasperma, 440
Gibberellin, some cytological effects of, 356
Glass support for plant tissue pieces cultured in liquid medium, 29
Gleichenia pectinata, 265
Glycine max, 69, 70
Grafts, male and female of *Mercurialis annua*, 1
Guilandinia, 69
Gymonota, 196
Gymnocladus, 69
Habenaria fimbriata, 57
HARLEY, WINIFRED J.: Ferns of Liberia (Review), 321
HAUKE, RICHARD L.: The stomatal apparatus of *Equisetum*, 178
Helicostylum, 31, 32, 37; *elegans*, 32, 37; *nigricans*, 32
HELSOP-HARRISON, J.: New concepts in flowering-plant taxonomy (Review), 139
HESSELTINE, C. W. AND PATRICIA ANDERSON: Two genera of molds with low temperature growth requirements, 31
Hieracium, 172
Hilaria, 118; *belangeri*, 118; *mutica*, 118
HIRES, CLARA S.: (Review), 321, 322
Histogenesis of the leaf structure of the shoot apex in *Glycine max* (L.) Merrill, 163
Hutcheson Memorial Forest, plant communities of, 198
Hydrocotyle, 192; **Macbridei, 191, 192; nixoides, 192**
Hylocomium, 342
Hypnum atrovirens, *281* 289, 290; *congestum*, 281, *297*; *filamentosum*, *281*, 290; *incurvum*, 290; *mutabile*, 281; *plicatum*, 281, *339*; *radicosum*, *297*, 339; var. *gracilis*, *337*; *rugulosum*, *339*; *tenax*, 281, *297*
Hypoxylon fuscum, 432

Impatiens capensis, 202
Index to American botanical literature, 59, 141, 219, 324, 398, 459
INGRAM, JOHN: New names in *Argythamnia* subgenus *Ditaxis*, 421
Isothecium striatum, 345; var. *saxicola*, 346
Iva frutescens, 57
Juglans cinerea, 452
Juncus effusus, 203, 204
Juniperus virginiana, 204
KARLING, JOHN S.: *Synchytrium cinnamomeum*, 237
Lachnea, 435, 438, 440; *abundans*, 431, 435, 436, 439, 440, 441
LAMPTON, ROBERT K.: Floral morphology in *Asimina triloba* Dunal I. Development of ovule and embryo sac, 151
LANGE, CLARENCE T. AND PAUL R. DESJARDINS: A glass support for plant tissue pieces cultured in liquid medium, 29
Lathyrus latifolius, 69; *odoratus*, 69
LAWTON, ELVA: A revision of the genus *Lescuraea* in Europe and North America, 281, 337
LEHR, J. HARRY: An annotated preliminary catalogue of the vascular flora of Rockland County, New York, 48, 126, 206, 310, 388, 450
Leptohymenium striatum, 345
Lescuraea, 281, 282, 283, 284, 285, 297, 344, 346, 351, 352; *atricha*, 285, 304, 306, 307, 344; *atrovirens*, 290; var. *Saviana*, *295*; **baileyi**, 282, 283, 285, **342**, 343, 344, 346; *denudata*, *303*; var. *hyperborea*, 303; *filamentosa*, 290; *frigida*, *346*, 349; **iliamniana**, 282, 283, 284, 285, 344, **349**, 350, 351, 352; imperfecta, 337; *incurvata*, 282, 285, 286, 290, 293, 294, 295, 296, 306, 351; var. *filamentosa*, 294; var. **gigantea**, 285, 292, 293, **294**, 352; var. *incurvata*, **291**, **292**, 293, 294; var. *tenella*, 293, *294*; var. **tenuiretis**, 293, **294**; *insignis*, *346*; *julacea*, 351; *mutabilis*, *345*; var. *decipiens*, *346*; *patens*, 281, 285, 287, **288**, 290, 291, 293, 295, 297, 307, 337, 339, 348, 351, 352; var. *gigantea*, 291; var. *incurvata*, 291; var. *tenuiretis*, 291; *plicata*, 285, 339, 341, 344, 346; *radicosa*, 282, 293, 294, 297, 301, 302, 305, 306, 339, 342, 351; var. *balanica*, 306; var. *compacta*, 286, 298, 299, 305; var. *denudata*, 285, 294, 299, 302, 304, 305, 341; var. *pallida*, 286, 298, 299, 306; var. *Pfundtneri*, *297*; var. *radicosa*, 286, 298, 299, 301, 302, 305, 306; f. *bernardensis*, 299, 301; f. *holzingeri*, 299, 302, 305; f. *jemtlandica*, 299, 301; f. *radicosa*, 299; *rigescens*, *337*; *saviana*, 285, 286, 292, 295, 296, 297, 307, 351; var. *meridionalis*, 296; *saxicola*, 281, 285, 346, 347, 348, 349, 350, 351, 352; *stenophylla*, 284, 285, 286, 287, 301, 307, 337, 338, 339, 352; *striata*, 281, 285, *345*, 346, 348, 349, 350; var. *saxicola*, 281, *346*
Leskea atrovirens, 290; *brachyclados*, *296*; *catenulata* var. *acuminata*, 351; *filamentosa*, 290; *incurvata*, 281, 287, 289; var. *brachyclados*, 296; *mutabilis*, *345*; (?) *patens*, 287; *rigescens*, 281, *337*; *Saviana*, *295*
Leskeella, 282
Lesquereuxia, *281*, 282; *atrovirens*, 287; var. *patens*, 287; *filamentosa*, 281, 290; *glacialis*, 351; *mutabilis*, 345; *patens*, 287; *plicata*, 281, *340*; *robusta*, 282, 344; *saxicola*, 281, 346
Leucothoe racemosa, 200, 202
Linaria vulgaris, 204
Lindera benzoin, 200, 202
Linnaea borealis, 57
Lisianthus, 46; *axillaris*, 46; *brevidentatus*, 46; **petenensis**, **46**
Lisianthus, New from Guatemala, 46
Lobeliod, Rediscovery of a rare, *Brighamia insignis* forma *citrina*, 175
Lolium multiflorum, 204
Lonicera japonica, 204
Lupinus, 70, 190; *albus*, 69; *dunetti*, 69; *grandiflorus*, 69; *hybridus*, 69; *mutalilis*, 69; *nanus*, 69
Luzula campestris, 202
Lycopodium adpressum, 57; *tristachyum*, 452
Macounia sciuroides, 297
MAINS, E. B.: Species of *Cordyceps* parasitic on *Elaphomyces*, 243
Marattia Douglasii, 176
Marine algae of the Northeastern coast of North America (Review) 454
Marsilea, 86; *quadrifolia*, 452
Marsh grass, Decomposition of, by aerobic marine bacteria, 366
MARTIN, WILLIAM E.: (Review), 320; (Review), 396
Maschalocarpus striatus, 345
Massospora, 269
MATHIAS, MILDRED E. AND LINCOLN CONSTANCE: Four notable Umbelliferae from Peru, 189
MCCORMICK, JACK: (Review), 320

Melilotus alba, 204, 361; *officinalis*, 204, 361
Mercurialis annua, 1, 3, 7, 8
Microsynchytrium, 237, 241, 242
Mimosa, 69, 70; *pudica*, 69
MISRA G. AND G. SAHU: Physiology of growth and reproduction in Rice. I. Effect of plant growth substances on an early variety, 442
Molds with low temperature growth requirements, 31
MONACHINO, JOSEPH: *Cynanchum* in the New York area, 47
MONK, KARL D.: Plant communities of Hutcheson memorial forest based on shrub distribution, 198; (Review), 323
MORGAN, E.: The occurrence of *Codium* in Long Island waters, 384
Morus, 127, 168; *alba*, 127, 171, 172
MOUL, E. T.: (Review), 139
Mucor, 34; *mucedo*, 32
MURDY, WILLIAM H. AND HENRY N. ANDREWS, JR.: A study of *Botryopteris globosa* Darrah, 252
Myrica, 126; 452; *pensylvanica*, 126, 204
Nandina, 92; *domestica*, 92
Neckera striata, 345
NELSON, JOHN J.: (Review), 322, 396
Neurospora, 182, 185, 186, 187, 431, 432, 434, 436, 438, 439, 440; *crassa*, 183; *sitophila*, 438; *tetrasperma*, 183, 186; 433, 435, 438
Nicotiana tabacum, 229, 230, 231, 233, 236
Niering, William A.: (Review), 457
Niphogeton, 197
NORTHEN, HENRY T.: The complete book of greenhouse gardening (Review), 396
Notes, 215, 396
Nuphar, 129; *advena*, 129
Nymphaea, 130; *odorata*, 130
Nyssa sylvatica, 202
Oil drops and DeBary "bubbles" in ascospores, 431
Onoclea sensibilis, 203
OOSTING, HENRY J.: Life forms as age indicators (Review), 318; The study of plant communities (Review), 320
Opulus, 57
Opuntia cylindrica, 171
PAPENFUSS, GEORGE F.: (Review), 454
Panicum, 107, 119; *macrostachyum*, 99; *maximum*, 107, 110; *scheelei*, 103
Paraselinum, 189, 197; **Weberbaueri**, 195, 197
Paspalum, 107; *dilatatum*, 107
Patella, 440; *abundans*, 435
Paxina, 431
Pennisetum, 107, 119; *ciliare*, 107, 111, 115, 362; *clandestinum*, 107; *orientale*, 107; *ramosum*, 107; *setaceum*, 107; *villosum*, 107
Penthorum, 133; *sedoides*, 133
Peziza abietina, 431; *melaena*, 431
Phaseolus, 70; *multiflorus*, 69; *vulgaris*, 69, 361
Phenolase and polyphenolase studies in the development of endodermis in the genus *Smilax*, 9
Philadelphus, 361
Picea engelmanni, 204
Pinus ponderosa, 204; *rigida*, 57; *thunbergii*, 57
PIRONE, P. P., *Ganoderma lucidum*, a parasite of shade trees, 424
Pisum, 70; *salvatum*, 75; *sativum*, 69, 70
Plant classification (Review), 454
Plantago lanceolata, 204
Pleurage curvicolla, 432
Poa, 107, 119; *annua*, 116; *laxa* subsp. *flexuosa*, 119; *trivialis*, 203
Podophyllum pelatum, 201
Polygonatum biflorum, 201
Polygonum, 203
Polyporous lucidus, 424
Polytrichum ohioense, 204
Potentilla simplex, 204
Proceedings of the club, 122, 213, 317, 392
Prunus avium, 199; *serotina*, 200, 201; *virginiana*, 200, 201
Pseudoleskea, 281, 282, 283, 285, 286, 342, 344, 352; *arizonae*, 351; *Artariae*, 351; *atricha*, 306; *atrovirens*, 281, 287, 290, 296, 307, 348, 351; *atrovirens* spp. *atrovirens* var. *illyrica*, 295; *atrovirens* subsp. *filamentosa*, 290; *atrovirens* subsp. *tenella*, 351; *atrovirens* var. *atricha*, 306; *atrovirens* var. *brachyclados*, 296, 351; *atrovirens* var. *patens*, 287; *atrovirens* var. *tenella*, 290; *Baileyi*, 342; *bicolor*, 297, 300; *brachyclados* subsp. *borealis*, 351; *Breidleri*, 303; *catenulata*, 281; *congesta*, 281, 297; *decipiens*, 348, 349; *denudata*, 303, 305; *denudata* var. *Holzingeri*, 302; *falciuspis*, 291, 351; *filamentosa*, 290, 294, 295; *filamentosa* (*incurvata*), 296; *filamentosa* var. *meridionalis*, 295; *filamentosa* var. *tenella*, 295; *filamentosa* var. *tenuirctis*, 294; *frigida*, 346; *heterocladioides*, 287; *howei*, 297; *hyperboreum*, 303; *illyrica*, 295, 297; *incurvata*, 290; *jemtlan-*

dica, 301; *Liebmanii*, 281; *oligoclada*, 290, 291, 292, 293, 294; *pallida*, 305, 306, *pallida* var. *filescens*, 351; *patens*, 281, 287; *plicata*, 340; *plicata* subsp. *rhaetica*, 340; *plicatum* var. *erectum*, 340; *plicatum* var. *rhaeticum*, 340; *radicosa*, 296, 297, 302, 351, 352; *radicosa* forma *radicosa*, 301; *radicosa* spp. *Saviana*, 295; *radicosa* var. *bernardensis*, 301; *radicosa* var. *jemtlandica*, 301; *radicosa* var. *meridionalis*, 295; *radicosa* var. *radicosa* f. *jemtlandica*, 301; *radicosa* var. *tenella*, 297; *rigescens*, 337, 339, 352; *rigescens* var. *Howei*, 297; *Saviana*, 295; *sciuroides*, 297; *sciuroides* subsp. *denudata*, 303; *sciuroides* var. *denudata*, 302; *stenophylla*, 301, 337, 339; *striata*, 345; *striata* var. *saxicola*, 346; *subfalcata*, 352; *substriata*, 307, 346, 349; *ticinensis*, 293, 352

Pseudoleskeella, 282, 351; **arizonae**, **351**; **catenulata** var. **filescens**, 352

Pseudoleskeopsis, 282; *Artariae*, 351

Pseudomonas 370, 377, 378, 379, 381

Pseudotsuga taxifolia var. *glauca*, 204

Ptelea trifoliata, 452

Pterigynandrum mutabile, 345; *striatum*, 345

Pterogonium striatum, 284, 345

Ptychodium, 281 282, 352; *abbreviatum*, 352; *albidum*, 352; *decipiens*, 281, 346; *erectum*, 340; *hyperborea*, 302; *hyperboreum*, 302; *oligocladum*, 281, 302; *pallescens*, 352; *Pfundtneri*, 281, 297; *plicatum*, 281, 340; *trisulcatum*, 352

Puccinia graminis, 187

Pycnochytrium, 237, 242

Quercus, 275, 277; *alba; bicolor*, 202; *brittonii*, 57; *coccinea*, 201; *palustris, rubra*, 199; *saulii*, 57; velutina, 199

Ranunculus, 240, 242; *recurvatus*, 237; *subrigidus*, 452

Rauia subcatenulata, 281

Reading the landscape (Review), 458

Reproduction in *Setaria macrostachya*, 106

Rhododendron viscosum forma *glaucum*, 452

Rhus radicans, 200, 203; *vernix*, 57

Rice, Physiology of Growth and Reproduction in I. Effect of plant growth substances on an early variety, 442

RICKETT, H. W.: (Review), 140; (Review), 396; (Review), 458

ROBBINS, WILFRED W.: Botany: an introduction to plant science (Review), 323

Robinia Pseudo-Acacia, 69

Rockland County, New York, An annotated preliminary catalogue of the vascular flora, 48, 126, 206

Rollandia, 175

Rubus, 202

Saccharum, 107

Salsola kali, 57

Sambucus canadensis, 203

SCHWARTEN, LAZELLA: Index to American Botanical Literature, 59, 141, 219, 324, 398, 459

Scrophularia nodosa, 171

Selaginella apoda, 452

Serratia, 369, 370, 371, 372, 377, 378, 379, 380, 381

Setaria, 51, 94, 105, 106, 107, 116, 119; *berlandieri*, 99; *gibbosa*, 99; *italica*, 94, 106; **leucopila**, 94, 95, 99, 100, **101**, 102, 103, 104, 105, 106, 109, 110, 111, 112, 113, 115, 116, 117, 118, 119, 120; **macrostachya**, 94, 95, 97, 98, **99**, 100, 101, 102, 103, 105, 106, 107, 109, 110, 111, 114, 116, 117, 118, 119; *polystachya*, 103; *rigida*, **101**; **scheelei**, 94, **95**, **103**, 104, 105, 106, 110, 111, 112, 115, 116, 117, 119; *setosa*, 98; **texana**, 94, 95, **97**, 98, 99, 100, 102, 103, 105, 106, 109, 110, 111, 115, 116, 117; **villosissima**, 94, **95**, 96, 97, 105, 106, 109, 110, 111, 113, 115, 117, 118, 119, 120, 362; *vulpiseta*, 99

Smilacina racemosa, 201

Smilax, 9, 10, 13, 16, 20, 21, 23, 25, 27; *auriculata*, 10, 14, 16; *Bona-nox*, 10, 16, 17, 18, 23, 24; *Bona-nox* var. *littoralis*, 10; *californica*, 9, 11; *ecirrhata*, 11; *glauca*, 10, 15, 16, 18; *havanensis*, 10, 13, 14, 16; *herbacea*, 11; *hispida*, 10, 12, 14, 16, 23, 24; *hispida* var. *hispida*, 10, 12, 13, 16, 23; *hispida* var. *montana*, 10, 12, 13, 14; *lanceolata*, 10, 13, 14, 16; *lasioneuron*, 11; *laurifolia*, 10, 13, 16, 17; *pumila* 10, 17, 18; *rotundifolia*, 10, 12, 13, 16, 17, 18, 23, 200, 202; *rotundifolia* var. *montana*, 12; *Walteri*, 10

SMITH, PAUL G. AND CHARLES B. HEISER, JR.: Taxonomy of *Capsicum sinense* Jacq. and the geographic distribution of the cultivated Capsicum species, 413

Solidago, 204

Sordaria, 431, 432; *fimicola*, 432

Sorghum, 157, 158, 161; *intrans*, 158; *stipoideum*, 158

Spartina, 366, 367, 373, 375, 376, 381, 382, 383; *alterniflora*, 366

SPEESE, BERNICE M.: *Flagellaria guineensis*, 90

Sphaeria capitata, *247*, 248; *ophioglossoides*, 245
Spongomorpha arcta, 386
Spontaneous production of a morphologically distinct, fertile allopolyploid by a sterile diploid of *Asplenium Ebenoides*, 79
STANDLEY, PAUL C. AND JULIAN A. STEYERMARK: A new *Lisianthus* from Guatemala, 46
STONE, BENJAMIN C.: Rediscovery of a rare lobelioid, *Brighamia Insignie* forma *Citrina*, in Kauai, Hawaiian Islands, 175
Streptopus amplexifolius, 57; *roseus*, 57
SUN, C. N.: Zonation and organization of root apical meristem of Glycine Max., 69; Histogenesis of the leaf structure of the shoot apex in *Glycine max* (L.) Merrill, 163
Symplocarpus foetidus, 53, 202
Synchytrium, 241, 242; *andinum*, 242; *brownii*, 241; *cinnamomeum*, 237, 238, 239, 240, 241, 242; *endobioticum*, 240; *holwayi*, 240; *ranunculi*, 242; *succisae*, 239; *variabilum*, 240, 242
Syringa, 172
Thamnidium, 31, 32, 33; *chaetocladioides*, 31, *33*; *elegans*, 31; *fresenii*, 33
Thesium, 361
Thuja plicata, 204
Torrey Botanical Club, Constitution and By-laws, 122
Torreya, 47, 122, 198, 308, 388, 450
Torrubia capitata, 248; *parasitica*, 245
Tradescantia, 171
Trematolobelia, 175
Trichocereus spachianus, 171
Tricholeskea, 282, 285
Trifolium hybridum, 204; repens, 70
Tripsacum, 107
Tsuga hetedophylla, 204
Tunica corpus and anneau initial of *Nicotiana tabacum*, 229
Tylophora, 47
Ulmus americana, 202
Umbelliferae from Peru, 189
Utricularia, 361; *coerulea*, 362
VAN FLEET, D. S.: Histochemical studies of phenolase and polyphenolase in the development of the endodermis in the genus *Smilax*, 9
Vanilla, 171
Vascular flora, an annotated preliminary catalogue of Rockland County, New York, 48, 126, 206, 310, 388, 450
Veronica myrtifolia, 171
Verticillium albo-atrum, 428
Viburnum acerfolium, 199, 200; *prunifolium*, 200, 201
Vicia, 77; *faba*, 217; *narbonensis*, 69; *sativa*, 69; *villosa*, 70
Vinca minor, 171
Vincetoxicum fuscatum, 47; *luteum*, 47; *medium*, 47; *nigrum*, 47
WAGNER, W. H. JR. AND ROBERT WHITMIRE: Spontaneous production of a Morphologically distinct, fertile allopolyploid by a sterile diploid of *Asplenium Ebenoides*, 79
WEAVER, J. E. AND F. W. ALBERTSON: Grasslands of the Great Plains (Review), 138
Werneria dactylophylla, 190
YAMPOLSKY, CECIL: Further experiments with male and female grafts of *Mercurialis annua*, 1
YUNCKER, T. G.: A new *Cuscata* from South Africa, 429; (Review), 456.

MEMOIRS OF THE TORREY BOTANICAL CLUB

50 monographs have been published as Memoirs of the Torrey Botanical Club since the series was initiated in 1889. Nearly all of these are still available at prices ranging from $0.25 to $5.00. The titles listed below are among those still in print:

Vol. 1, No. 4.—Sturtevant, E. L.—On seedless fruit. 1890. 75¢

Vol. 2, No. 2.—Vail, A. M., and A. Hollick.—Contributions to the botany of Virginia. 1890. 75¢

Vol. 2, No. 3.—Holm, T.—Contributions to the knowledge of the germination of some North American plants. 1891. $1.00

Vol. 6, No. 3.—Hazen, T. E.—The life history of *Sphaerella lacustris* (*Haematococcus pluvialis*). 1899. 50¢.

Vol. 7.—Howe, M. A.—The Hepaticae and Anthocerotes of California. 1899. $3.00

Vol. 12, No. 1.—Northrop, A.—Flora of New Providence and Andros (Bahama Islands). 1902. $1.50

Address Orders and requests for complete lists of titles to

Dr. Jack McCormick
The Torrey Botanical Club
c/o The American Museum of Natural History
New York 24, N. Y.

The INDEX TO THE BULLETIN OF THE TORREY BOTANICAL CLUB VOLUMES 1–75

(1870-1948)

compiled by Harold William Rickett
published in July 1955

It includes an alphabetical list of contributors, titles of their publications, and subject index.

The Bulletin of the Torrey Botanical Club is the oldest botanical journal in the United States. An INDEX to its first SEVENTY-FIVE VOLUMES which covered a period of great growth in botanical science should prove a valuable tool for the researcher and teacher.

Special type indicates new names and combinations and distinguishes place of casual mention and listings in synonymy.

PRICE $15.00

Dr. Jack McCormick
The Torrey Botanical Club
The American Museum of Natural History
New York 24, N. Y.

MAXIMUM STORAGE

Lane Herbarium Case
The Accepted Standard for general use

Lane HERBARIUM CASES

NOW IN USE IN OVER 115 UNIVERSITIES, BOTANICAL GARDENS, NATIONAL PARKS, ETC. since their introduction!

SPECIFICATIONS

STANDARD HERBARIUM
84 1/8" High, 27-13/16" Wide, 18-25/32" Deep

JUNIOR MODEL HERBARIUM
40" High, 27-13/16" Wide, 18-25/32" Deep

SOME USERS OF LANE HERBARIUM CASES

New York Botanical Gardens
Abilene Christian College
Agricultural & Mechanical College of Texas
Duquesne University
Florida State University
Georgia Teachers College
Louisiana Polytechnic Institute
Loyola University
Oklahoma Agricultural & Mechanical College
Southern Methodist University
State College of Washington
Tulane University
University of Alabama
University of Arizona
University of Arkansas
University of Chattanooga
University of Massachusetts
University of Idaho
University of Nevada
University of Texas
University of Wisconsin
Washington University
Yale University
Grand Canyon National Park
Olympic National Park
Hawaii National Park
Glacier National Park
Canisius College
Catholic University of Washington
Carleton College
Emory University
U. S. Dept. of Agriculture
Oregon State College
Riverside Municipal Museum
Rutgers University

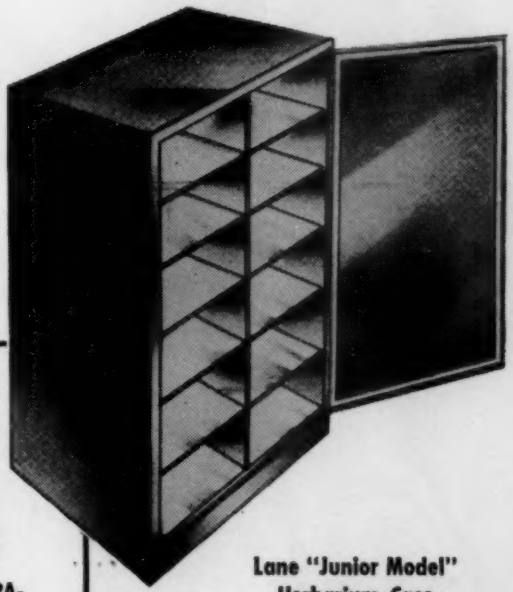
PROTECTION

JUNIOR MODEL HERBARIUM CASE

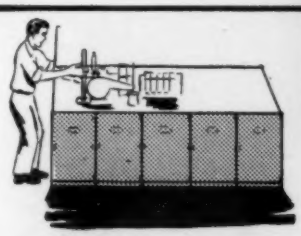
CHECK THESE OUTSTANDING FEATURES:

- Air-Tight and Insect Proof Seal
- Standard Size Compartments
- Three-Point Compression Type Locking Mechanism
- Effective Air Circulation and Fumigation
- Right or Left Doors
- Double-Wall All-Steel Construction

IDEAL FOR SUPPLEMENTAL USE, WORK TABLE, UNDER WINDOWS, SMALL COLLECTIONS, STUDENTS, ETC.



Lane "Junior Model" Herbarium Case



A WORK TABLE IN THE LABORATORY WITH LINOLEUM COVERED WORKING TOP.

ALL LANE HERBARIUM CASES ARE DELIVERED COMPLETELY ASSEMBLED AND READY FOR USE.

WRITE FOR COMPLETE DETAILS.

Institutional Division CHAS J Lane CORP

105 CHAMBERS STREET, NEW YORK 7, N. Y.